THE

PHILOSOPHICAL MAGAZINE:

COMPREHENDING

THE VARIOUS BRANCHES OF SCIENCE,

THE LIBERAL AND FINE ARTS,

AGRICULTURE, MANUFACTURES,

AND

COMMERCE.

BY ALEXANDER TILLOCH,

MEMBER OF THE LONDON PHILOSOPHICAL SOCIETY, ETC. ETC.

"Nec aranearum ſane textus ideo melior, quia ex ſe fila gignunt. Nec noſter vilior quia ex alienis libamus ut apes." JUST. LIPS. *Monit. Polit.* lib. i. cap. 1.

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OF THE

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THE

PHILOSOPHICAL MAGAZINE.

FEBRUARY 1800.

I. *A new and expeditious Process for rendering Platina malleable. By Mr.* Richard Knight, *Member of the British Mineralogical Society. Communicated by the Author.*

THE many peculiar advantages which platina in a malleable state possesses over every other metal for the fabrication of a variety of instruments and utensils particularly useful for the purposes of chemistry, together with the extreme difficulty of procuring it, being hitherto only to be obtained from Paris, of a very indifferent quality, and at a price equal to that of gold, first induced me to turn my attention to the subject. After having repeated a variety of experiments, from the different writers on this substance, without effect, I at length completed a process, the success of which has fully answered my expectations. By the process which I follow I am able to reduce any quantity of crude platina to a perfectly malleable state, entirely free from impurity, and capable of being wrought into any form whatever. As this is a circumstance of considerable importance to the chemical world, and the advantages which may result from it to society in general are perhaps incalculable, I would consider myself deserving of censure, could I allow any motive whatever to induce me to withhold it from the public. By sending it for publication in a work of such extensive circulation as the

Philosophical Magazine, it will meet the eyes of those for whom it is intended. If any benefit result from it to science, or the arts, my end is gained, and I shall feel amply repaid for my trouble. The method I pursue is as follows:—

To a given quantity of crude platina I add 15 times its weight of nitro-muriatic acid (composed of equal parts of nitric and muriatic acids) in a tubulated glass retort, with a tubulated receiver adapted to it. It is then boiled, by means of an Argand's lamp, till the acid has assumed a deep saffron colour: it is then poured off; and if any platina remains undissolved, more acid is added, and it is again boiled until the whole is taken up. The liquor, being suffered to rest till quite clear, is again decanted: a solution of sal-ammoniac is then added, by little and little, till it no longer gives a cloudiness. By this means the platina is thrown down in the form of a lemon-coloured precipitate, which having subsided, the liquor is poured off, and the precipitate repeatedly washed with distilled water till it ceases to give an acid taste; (too much water is injurious, the precipitate being in a certain degree soluble in that liquid:) the water is then poured off, and the precipitate evaporated to dryness.

So far my process is in a great measure similar to that which some others have also followed; but my method of managing the subsequent, and which are indeed the principal manipulations, will be found to possess many advantages over any that has yet been made public. The best process hitherto followed has been, to give the precipitate a white heat in a crucible, which in some measure agglutinates the particles; and then to throw the mass into a red-hot mortar, or any similar implement, and endeavour to unite them by using a pestle or stamper. But the mass is so spongy that it is hardly possible to get a single stroke applied to it before the welding heat is gone; and though by peculiar dexterity and address some have in this way succeeded, it has been found to require such innumerable heatings and hammerings, that most of those who have attempted it, have either failed entirely, or given it up as being too laborious and expensive. I have succeeded in obviating all these difficulties, by adopting the following simple, easy, and expeditious method:—

A strong,

A ſtrong, hollow, inverted cone of crucible earth being procured, with a correſponding ſtopper to fit it, made of the ſame materials, the point of the latter is cut off about three-fourths from the baſe. The platina, now in the ſtate of a light yellow powder, is preſſed tight into the cone, and, a cover being fixed ſlightly on, it is placed in an air-furnace *, and the fire raiſed gradually to a ſtrong white heat. In the mean time the conical ſtopper, fixed in a pair of iron tongs ſuitable for the purpoſe, is brought to a red, or to a bright red heat. The cover being then removed from the cone, the tongs with the heated ſtopper is introduced through a hole in the cover of the furnace, and preſſed at firſt gently on the platina, at this time in a ſtate nearly as ſoft as dough, till it at length acquires a more ſolid conſiſtence. It is then repeatedly ſtruck with the ſtopper, as hard as the nature of the materials will admit, till it appears to receive no farther impreſſion. The cone is then removed from the furnace, and being ſtruck lightly with a hammer, the platina falls out in a metallic button, from which ſtate it may be drawn, by repeatedly heating and gently hammering, into a bar fit for flatting, drawing into wire, planiſhing, &c.

Beſides the comparative facility of this proceſs, it has the farther advantage of rendering the platina much purer than when red-hot iron is obliged to be had recourſe to; for platina, when of a white heat, has a ſtrong affinity for iron, and, with whatever care it may have been previouſly ſeparated from that metal, will be found to have taken up a portion of it, when it is employed, of a red heat, to ſerve to unite the particles of the platina. To the ſuperior purity of platina, rendered malleable by the proceſs before deſcribed, I attribute the greater ſpecific gravity which I find it to poſſeſs, than that prepared by other methods. Having taken the ſpecific gravity of about ten penny weights of it, which I had previouſly paſſed repeatedly through a flatting mill, I found it to be 22·26.

Foſter Lane, January 3, 1800.

* The one I employ is portable, and the chamber for the fire only eight inches in diameter. K.

II. *Reflections on Pruſſiats.* *By* I. M. HAUSSMANN *.

TO fix on ſtuffs with ſucceſs the metallic pruſſiats, it was neceſſary to examine with care the reſults ariſing from the mixture of metallic ſolutions with the pruſſiats of pot-aſh or of lime. The moſt intereſting information which I procured by my experiments is as follows:—

The red oxyd of mercury ſubjected to the action of the liquor of pruſſiat of pot-aſh or of lime, acidulated by the ſulphuric acid, did not produce blue, but was transformed gradually into yellowiſh ſulphat of mercury: next morning, after an addition of the muriatic acid, the change took place in an inſtant, and I obtained a blue exceedingly brilliant. Having, inſtead of the ſulphuric acid, employed the muriatic, the red oxyd was diſſolved, and the liquor became tranſparent, of a bad blue colour, which became gradually brighter as it was precipitated. The red oxyd of mercury, diſſolved firſt by the nitric acid in exceſs, to which was added pruſſiat of pot-aſh or of lime, furniſhed alſo a blue. The operation is ſlow when the red oxyd is uſed without diſſolving it, and when you confine yourſelf to acidulating the pruſſiat with the nitric acid. An aqueous ſolution of the oxygenated muriat of mercury, mixed with a ſolution of pruſſiat of pot-aſh or of lime, acidulated by the muriatic or nitric acid, gives alſo a very beautiful blue.

In all theſe proceſſes of mercury, and particularly the laſt, a part of this oxygenated ſubſtance remains in ſolution, and reſembles the liquor obtained by deſtroying the colour of the pruſſiat of iron by means of the red oxyd of mercury and of water. The oxyd of ſilver is changed with more difficulty. I diluted with water a nitric ſolution of that metal; and when I hit the juſt proportions of the pruſſiat of pot-aſh, and the ſulphuric or muriatic acid, I obtained, by ſhaking from time to time, the moſt beautiful blue in the ſpace of twenty-four hours. The liquid arſenic acid, mixed with pruſſiat of pot-aſh or of lime, acidulated with ſulphuric acid, gives a very beautiful blue.

* From *Journal de Phyſique*, an. 7.

A ſolution

A ſolution of cobalt furniſhes a greyiſh violet, and, with the addition of muriat of ammonia, a beautiful violet blue; while, in treating ſolutions of the ſulphat of zinc, the nitrat of biſmuth, the muriat of tin, and the acetite of lead, with liquor of the pruſſiat of pot-aſh or of lime, acidulated as before, you obtain only whites. Copper is precipitated under a brown ſhade. The muriat of antimony, precipitated by aqueous dilution, and expoſed, like the oxyd of ſilver, to the action of the acidulated pruſſiat of pot-aſh, indicates ſome diſpoſition to become blue. Adding to the muriatic ſolution of the black oxyd of manganeſe, muriat of ammonia, and mixing this ſolution with liquor of the pruſſiat of pot-aſh, acidulated by the ſulphuric acid, there is formed a very beautiful blue.

I muſt inform chemiſts not to be diſcouraged when the production of blue does not immediately take place; if it ſhould happen that they do not obtain it, they muſt vary the proportions until they have accompliſhed their end. The blue of ſilver often does not ſucceed till after a long time, and does not acquire its utmoſt degree of intenſity till the end of eight, ten, or fifteen days.

As I intended to repeat and continue theſe experiments by the mixture of metallic ſolutions with liquor of the pruſſiats of pot-aſh and lime acidulated, I firſt expoſed to the action of theſe liquors, ſome metallic oxyds fixed upon ſtuffs. Cotton cloth, which had imbibed a ſolution of native platina almoſt inſenſible to the magnet, after being wrung was dipped, without drying it, in a ſolution of cauſtic pot-aſh; the oxyd of platina remained, in a great part, adhering to the ſtuff, which being waſhed, aſſumed a yellow much more beautiful than that obtained from iron. Having dipped this cloth in a ſolution of pruſſiat of pot-aſh or of lime, acidulated by the ſulphuric acid, I obtained as lively a blue, and in as ſhort a time as if I had employed cloth coloured by the oxyd of iron. A mixture of the ſolution of platina and of tin diſſolved in the muriatic acid, with an exceſs of acid, is of a beautiful tranſparent red colour. Without exceſs of acid, there is formed, at firſt, a precipitate of a beautiful

orange

orange colour. This procefs might furnifh another means of purifying platina.

A piece of cotton cloth impregnated with a folution of gold, containing a fixth part of that metal without excefs of acid, being plunged in a folution of ammonia, furnifhed me with an ochre yellow. This yellow at length became blackifh after being kept in a fheet of paper. As alkaline liquors, and particularly that of the carbonat of pot-afh or of foda, have a great tendency to diffolve the oxyd of gold, it cannot be ufed for its precipitation on cloth. Cloth coloured yellow by gold dipped in muriat of tin diluted with water, undergoes a change into dark blackifh grey, which becomes brighter in proportion as the folution is diluted. I have often obtained violets and lilacs by dipping, without precipitation, the cloth merely imbibed with a folution of gold, in nitro-muriatic folutions of tin prepared with different proportions of the acid. Several fhades of gold colour will be obtained by precipitating oxyd of tin from its nitro-muriatic folution by dilution with water, to which a folution of gold has been added, drop by drop, at different times, with intervals of feveral hours. This mode of operation will furnifh orange colours, while, if you fubftitute oxyd of gold for the folution, you will obtain lilacs, which, approaching more and more to fhades of crimfon, will at laft become orange, if you continue to add to them, from time to time, oxyd of gold. Thefe fhades depend a great deal on the proportion of muriatic acid prefent in the nitro-muriatic folution of tin. If it contains too great a quantity, the dofe of water muft be augmented to make the oxyd of tin precipitate itfelf, and the gold in that cafe gives a grey colour more or lefs reddifh. The folution of tin, which I employed for thefe experiments, was compofed of four parts of nitric acid, one of muriatic acid, and one and a quarter of granulated tin, flowly diffolved, to prevent, as much as poffible, the nitrous gas from being difengaged in too great quantity. Thefe oxyds of tin, coloured by the oxyd of gold more or lefs de-oxygenated, do not require much metal, and confequently are not dear. They all prefent, when dry, different fhades of grey and lilac more or lefs intenfe, and in all probability might be employed for painting porcelain.

Stuff

Stuff coloured by the oxyd of gold ſeems to attract the colouring particles of madder, and aſſumes a reddiſh-brown tint, or a ſort of carmelite, which is more and more blackened by a continuation or increaſe of the heat. The other ingredients proper for dyeing alſo blacken gold by the help of heat. Galls, by ebullition, have an analogous effect, and produce almoſt the ſame greyiſh-black colour as that obtained by dipping in a muriatic ſolution of tin, probably becauſe all theſe means de-oxygenate the oxyd of gold. The change into blue, of ſtuff coloured yellow by the oxyd of gold expoſed to the action of diſſolved pruſſiat of pot-aſh or of lime, acidulated by the ſulphuric or any other acid, takes place only ſlowly. Three, four, and even five hours immerſion are neceſſary to obtain a beautiful blue of equal intenſity with the yellow produced by gold. By acidulating too ſtrongly the liquor of the pruſſiat, the oxyd of gold diſſolves without giving a blue.

It is not uncommon to ſee the experiment fail when the ſolution of gold is directly mixed with a ſolution of an alkaline pruſſiat or a pruſſiat of lime. Every thing here depends on the degree of acidulation; but the experiment will generally ſucceed when the oxyd of gold has been previouſly precipitated by ammonia or ſome other alkali.

I for a long time imagined that theſe blues aroſe from the metal employed, and formed pruſſiats. I was ſo full of this idea, that, when I made the diſcovery in 1781, I communicated it to the celebrated profeſſor Spielmann, who returned me the following anſwer:—“ Weſtenberg, in a diſſertation maintained at Gottingen in 1772, and Martin more amply in a theſis printed here in 1775, remarked, that ley of blood precipitated gold under a blue colour; but that, to obtain this colour, it was neceſſary to make uſe of an acid. The latter obſerved chiefly, that alkali, ſaturated with pruſſian blue, precipitated gold immediately of a blue colour; and that, if ley of blood was deprived of all volatile alkali by diſtillation, the reſiduum, more concentrated, dyed ſtill more eaſily the metals it precipitated from their menſtrua.” At the time when I was employed in repeating my experiments, my friend Charles Bartholdi objected to me, that all my blues

blues aroſe only from iron, which the ſolutions of pruſſiats of pot-aſh and of lime hold more or leſs in ſolution. I learned alſo, from a paſſage in Buffon in his obſervations on the nature of platina, that Morveau had doubted the experiment of Fourci, who precipitated gold of a blue colour by the pruſſian alkali. Though we cannot deny the exiſtence of iron in pruſſiats of alkalies and of lime, I could, however, with difficulty believe that a metallic ſubſtance fixed on ſtuff, could be replaced by any other which would at the ſame time remain fixed.

If, in my experiment on cloth coloured by the oxyd of gold, that oxyd had diſappeared; if the pruſſiat of iron had been precipitated in the liquor, inſtead of being fixed on the ſtuff; if the aſhes of ſome ſpecimens had not gilded ſilver; and, in the laſt place, if the intenſity of blues had not been ſo conſiderable and ſo general, and the ſhades of each different, I ſhould certainly have been ſooner freed from my error; but I now am, and the following is the method in which I proceeded to convince myſelf of my miſtake:—I deprived of its colour, by means of a ſolution of pot-aſh, a piece of cotton cloth coloured yellow by gold, and then rendered blue: I waſhed it, and immerſed it for ſeveral hours in a muriatic ſolution of tin, and produced the ſame effect as with the oxyd of iron. This cloth, deprived of its colour, and become of a yellow ſimilar to that produced by the oxyd of iron, was changed into blue by alkaline pruſſiats as ſpeedily as the latter. This blue cloth, as well as that deprived of its colour by pot-aſh when reduced to aſhes, ſcarcely gilded ſilver; and theſe aſhes, treated with mercury, furniſhed only a ſlight gilding, ariſing no doubt from a ſmall portion of the oxyd of gold which had remained untouched in the liquor of the acidulated pruſſiats, which, by longer immerſion of the ſtuff, could not have failed to have been taken up.

Theſe proofs were too ſtriking not to induce me to continue my experiments. I ſoaked, therefore, the cotton cloth in a nitric ſolution of ſilver, and, without drying it, I dipped it in a ſolution of cauſtic pot-aſh; the oxyd fixed on the ſtuff preſented inequalities, and exhibited different ſhades of violet, lilac, grey, and yellow. The action of the atmoſphere

had a great influence on the tone of theſe ſhades. The ſtuff, after being dried, was left for fifteen days in a ſolution of pruſſiat of pot-aſh acidulated by the nitric, muriatic, or ſulphuric acids, and aſſumed a pretty equal blue colour, of great beauty and ſplendour; but, when deprived of its colour by cauſtic pot-aſh, it could not be brought back to its firſt ſhades. The yellow preſerving a decided ſuperiority ſeemed to obſcure the reſt; which ſhews that the pruſſiat of iron had diſplaced a great part of the oxyd of ſilver.

The nitric ſolution of the red oxyd of mercury, with which I impregnated the cotton in order to dip it in a ſolution of cauſtic pot-aſh, gave a very beautiful yellow, while the nitric ſolution of mercury, newly made, produced a grey; but theſe two ſhades, having been left ſome days in the ſolution of the pruſſiat of pot-aſh acidulated by the nitric, muriatic, or ſulphuric acids, were changed into blue. The colour being afterwards diſcharged by cauſtic alkali, the grey and yellow ſhades re-appeared—with this difference, that the latter had a greater reſemblance to the ruſt of iron. What is ſingular is, that the grey differed very little from its firſt ſhade: if, however, the grey oxyd of mercury had been obſcured by the pruſſiat of iron, diſcharging the colour muſt have produced an ochre yellow.

All theſe experiments preſent phenomena ſo ſingular that they deſerve to be repeated; which I ſhall perhaps do; but in the mean time it appears to me true that the greater part of theſe blues are only pruſſiat of iron: the changes by affinity, however, are extraordinary. It is, above all, on the grey oxyd of mercury changed blue, that it is of importance to fix attention.

As the precipitates which are formed in mixtures of metallic ſolutions with ſolutions of pruſſiats, of alkalies, or of lime, acidulated, though not blue, are ſtill pruſſiats under different colours, it is very probable that the metallic oxyds, ſuch as that of gold fixed on ſtuff deſtined to be changed into blue, become pruſſiats, ſoluble in acids. In regard to the blue of platina, I have no doubt that it is a pruſſiat of that metal; its change is effected as ſpeedily as that of iron.

 III. *Account*

III. *Account of a simple and effectual Preparation of Seed-Corn. By Mr.* JOHN WAGSTAFFE, *of Norwich* *.

THERE has been long sought for, and, in the opinion of some, long since obtained, a perfect cure of the disease in wheat and other grain, provincially known by various names, as smut, soot-brand, &c. which are but one and the same disease.

From the partial judgment of many individuals, it has been asserted, that such and such caustics, salts, and washes, have been completely destructive of this bane; yet, however such individuals may have escaped its malignity, the repeated use of their recipes has not succeeded with others to whom their process has been communicated: but I am convinced, by a series of repeated experiments, that every person, who duly practises the simple means I now lay before you, will be exempted from its immediate bane; and a district of country, by pursuing the same means, may perhaps escape future contagion.

The means are simple; and are no other than immersing the seed in pure water, and repeatedly scouring it therein, just before it is sown or dibbled in the soil. Whether well, spring, or river water be used, is indifferent; but repeated stirring and change of water is essential to remove the particles of infection that may have imperceptibly adhered to the seeds thus purified: the subsequent crop will be perfect in itself, and its seeds (I am persuaded) successively so likewise, if there are no adjacent fields from whence this contamination may be wafted. Before I give you a series of experiments, which have confirmed to me the complete cure of the disease in question, permit me to observe, that many years since, believing that this corrupt substance of smut occasioned its perpetuation, I took some grains of wheat from a stock that had been known not to be affected with smut; these grains I blackened with its dust, and the succeeding summer confirmed my opinion, as near half the produce was

* From *Letters and Papers of the Bath and West-of-England Society for the Encouragement of Agriculture*, &c.

smut-

smut-balls. Here I stopped; and in my own small practice used some of the strongly recommended nostrums that were said always to effect a cure, and which apparently they did, as I uniformly steeped the grain in rain water before I made the addition of a disgustful fluid, or commixture of I know not what strange substances.

About two years since, I was called upon by an intelligent farmer (Roger Tressey) of Devonshire, who *confidentially* (because he had a subscription in view) laid this simple process before me. I was immediately convinced, by comparing what I had practised with the principle he advanced.

I then repeated my former experiments. I took a handful of pure wheat, and blackened it, by rubbing in as much smut-brand as I was able; after which, I divided this corrupted handful into two equal parts; retained one part with all its corrupt impregnation*, and the other part I well cleansed in water from its baneful particles: these two parts I again subdivided into three portions each, two of which I dibbled in different situations, *viz.* a portion of the pure and impure, near to, but distinctly separated from, each other; two other portions some miles from the former two: and the remaining two (the corrupted and the cleansed) I committed to the care of an accurate neighbour for his putting into the ground, at which I was present, and witnessed the exactness of the separation. The products of these several trials were uniformly the same: the unwashed was generally smutty; the washed good in quality, one single set excepted. Thus fully convinced, and confirmed in the efficacy of the means recommended, I engaged the farmers of a certain parish (Baburgh) to advance me a guinea for Roger Tressey's publication, assuring the principal occupier †, that he would be convinced

* Wholesome water has a tendency to promote vegetation, while some of the fetid and corrosive fluids have a tendency to destroy its principle; in course, some, perhaps much, of the seed perishes in the soil.

† This farmer had been subject many years to brand, notwithstanding his constant use of saline and other substances: at length he changed these for a recipe from a gentleman to whose opinion he paid much deference; but it proved, that on this change he had more brand than before: he thence resolved to use no more preparations, but brought all his seed-

 wheat

convinced of its certainty, without waiting the issue of a harvest. The consequence of which has been, that I have neither seen nor heard of a smutty ear in this district; which, I believe, hath in no preceding year been free from them. In fine, not only from the experiments already adverted to, but from others which might be adduced, I am fully persuaded that the confirmation of this discovery (and it has been many years back suggested) will lead to an incalculable advantage; for it is not alone a preservation of the most indispensable article of human food from an appearance and flavour truly disgustful; but, while it renders it more nutritious, it also augments its quantity; for every smut-ball might have been a perfect grain, by using the simple process referred to. To this let me add, that other kinds of bread, as well as that more generally used, may be augmented and improved; since barley and oats equally escape this contamination and diminution, if their seeds are equally purified.

IV. *On the Distillation of ardent Spirit from Carrots. By Dr.* HUNTER *and Mr.* HORNBY, *of York**.

ONE ton and eight stone of carrots, which, after being exposed to the air a few days to dry, weighed one hundred and sixty stone, and measured forty-two bushels, were washed, topped, and tailed, by which they lost in weight eleven stone, and in measure seven bushels: being then cut, they were boiled, with the proportion of twenty-four gallons of water to one-third of the above quantity of carrots, until the whole was reduced to a tender pulp, which was done in three hours

wheat to the pump, and has not had (he says) any brand since. And, what is still more confirming, a gentleman farmer in this vicinity applied to me for Roger Tressey's process, in consequence of his whole crop of wheat being so excessively infected with smut, that his threshers daily, at the close of their labour, cleansed themselves *in* water, they being, as he expressed it, as black as chimney-sweepers: yet his subsequent crop of wheat from *this* seed, scoured in repeated washings, escaped the taint, except a piece of land in contiguity with the homestead; which this gentleman ascribed to the pollution which fled over it from divers dressings.

* From the *Transactions of the Royal Society of Edinburgh.*

boiling.

boiling. From this pulp the juice was eafily extracted, by means of a prefs, and two hundred gallons of juice were produced from the whole. This juice was boiled again, with one pound of hops, five hours, and then cooled to 66° of Fahrenheit; and, fix quarts of yeaft being added, it was fet to ferment. The ftrong fermentation lafted forty-eight hours, during which time the heat abated to 58° of Fahrenheit. Twelve gallons of unfermented juice, which had been referved, were then heated, and added to the liquor, the heat of which was thus raifed again to 66°, and the fermentation was renewed for twenty-four hours more, the air of the brewhoufe being all this time at 46° and 44°. The liquor was now tunned, and continued to work three days from the bung. Laftly, it was diftilled; and the firft diftillation was rectified the next day, without any addition. The produce was twelve gallons of fpirit *.

The refufe of the carrots weighed forty-eight ftone, which, added to the tops and tails, made provifion for hogs, befides the wafh from the ftill, which meafured one hundred and fourteen gallons.

From this experiment, which was made by Mr. Hornby, Dr. Hunter draws the following comparifon between the diftillation of carrots and that of grain:

Twenty tons of carrots, which will make two hundred gallons of proof-fpirit, may be bought for 16 *l.*

Eight quarters of malt, or rather of materials for diftillation, confifting of malt, wheat, and rye, may be bought for 16 *l.* and will alfo yield two hundred gallons of proof-fpirit.

The refufe from the carrots will be nine hundred and fixty ftone, which, at one penny *per* ftone, will fell for 4 *l.*

The refufe, or grains, from the malt, &c. will be fixty-four bufhels, each bufhel about three ftone, which, at one penny *per* ftone, will fell for 16 *s.*

Dr. Hunter, however, fuppofes that the manufacturing of the fpirit from carrots may be attended with more expence

* A fample of this fpirit, which was fent along with the paper, was examined by Dr. Black, Dr. Hutton, and Mr. Ruffell: they found that it refembled a corn fpirit in flavour, but that it was equal to a corn fpirit of the beft kind, and that it was proof.

than

than the manufacturing it from malt; but imagines that the greater value of the refuse may compensate for that expence; and that the saving of corn, for other purposes, is an object worthy of attention and encouragement.

V. *Some Account of the Elastic-Gum Vine of Prince of Wales's Island, and of Experiments made on the milky Juice which it produces; with Hints respecting the useful Purposes to which it may be applied.* By JAMES HOWISON, *Esq.**

OUR first knowledge of the plant being a native of our island arose from the following accident:—In our excursions into the forests it was found necessary to carry cutlasses for the purpose of clearing our way through the underwood. In one of those an elastic-gum vine had been divided, the milk of which drying upon the blade, we were much surprised in finding it possess all the properties of the American *Caoutchouc*. The vine which produces this milk is generally about the thickness of the arm, and almost round, with a strong ash-coloured bark, much cracked, and divided longitudinally; has joints at a small distance from each other, which often send out roots, but seldom branches; runs upon the ground to a great length; at last rises upon the highest trees into the open air. It is found in the greatest plenty at the foot of the mountains, upon a red clay mixed with sand, in situations completely shaded, and where the mercury in the thermometer will seldom exceed summer heat.

In my numerous attempts to trace this vine to its top, I never succeeded; for, after following it in its different windings, sometimes to a distance of two hundred paces, I lost it, from its ascending among the branches of trees that were inaccessible either from their size or height. On the west coast of Sumatra, I understand, they have been more successful; Doctor Roxburgh having procured from thence a specimen of the vine in flowers, from which he has classed it, but whose description I have not yet seen.

* From the *Asiatic Researches*, Vol. V.

With

With us the Malays have found tasting of the milk the best mode of discriminating between the elastic-gum vine and those which resemble it in giving out a milky juice, of which we have a great variety; the liquid from the former being much less pungent or corrosive than that obtained from the latter.

The usual method of drawing off the milk is by wounding the bark deeply in different places, from which it runs but slowly, it being full employment for one person to collect a quart in the course of two days. A much more expeditious mode, but ruinous to the vine, is cutting it in lengths of two feet, and placing under both ends vessels to receive the milk. The best is always procured from the oldest vines. From them it is often obtained in a consistence equal to thick cream, and which will yield two-thirds of its own weight in gum.

The chemical properties of this vegetable milk, so far as I have had an opportunity of examining, surprisingly resemble those of animal milk. From its decomposition in consequence of spontaneous fermentation, or by the addition of acids, a separation takes place between its caseous and serous parts, both of which are very similar to those produced by the same processes from animal milk. An oily or butyrous matter is also one of its component parts, which appears upon the surface of the gum so soon as the latter has attained its solid form. The presence of this considerably impeded the progress of my experiments, as will be seen hereafter.

I was at some trouble in endeavouring to form an extract of this milk so as to approach to the consistence of new butter, by which I hoped to retard its fermentative stage without depriving it of its useful qualities; but, as I had no apparatus for distilling, the surface of the milk, that was exposed to the air, instantly formed into a solid coat, by which the evaporation was in a great degree prevented. I however learned, by collecting the thickened milk from the inside of the coats, and depositing it in a jelly-pot, that, if excluded from the air, it might be preserved in this state for a considerable length of time.

I have kept it in bottles, without any preparation, tolerably

7 good,

good, upwards of one year; for, notwithſtanding the fermentation ſoon takes place, the decompoſition in conſequence is only partial, and what remains fluid ſtill retains its original properties, although conſiderably diminiſhed.

Not having ſeen M. Fourcroy's memoir on *Caout-chouc*, I could not make trials of the methods propoſed by him for preſerving the milk unaltered.

In making boots, gloves, and bottles, of the elaſtic gum, I found the following method the beſt:—I firſt made moulds of wax, as nearly of the ſize and ſhape of what they repreſented as poſſible; theſe I hung ſeparately upon pins, about a foot from the ground, by pieces of cord wrought into the wax: I then placed under each a ſoup-plate, into which I poured as much of the milk as I thought would be ſufficient for one coat. Having dipped my fingers in this, I completely covered the moulds one after another, and what dropped into the plates was uſed as part of the next coat: the firſt I generally found ſufficiently dry in the ſpace of ten minutes, when expoſed to the ſun, to admit of a ſecond being applied: however, after every ſecond coat, the oily matter before mentioned was in ſuch quantity upon the ſurface, that, until waſhed off with ſoap and water, I found it impoſſible to apply any more milk with effect; for, if laid on, it kept running and dividing like water upon wax.

Thirty coats I in common found ſufficient to give a covering of the thickneſs of the bottles which come from America. This circumſtance may, however, at any time be aſcertained by introducing the finger between the mould and gum, the one very readily ſeparating from the other.

I found the fingers preferable to a bruſh, or any inſtrument whatever, for laying on the milk; for, the moment a bruſh was wet with that fluid, the hair became united as one maſs. A mode which at firſt view would appear to have the advantage of all others for eaſe and expedition in covering clay and wax moulds with the gum, *viz.* immerſing them in the milk, did not at all anſwer upon trial; that fluid running almoſt entirely off, although none of the oily matter was preſent; a certain degree of force ſeeming neceſſary to incorporate, by friction, the milk with the new-formed gum.

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When, upon examination, I found that the boots and gloves were of the thickneſs wanted, I turned them over at the top, and drew them off, as if from the leg or hand, by which I ſaved the trouble of forming new moulds. Thoſe of the bottles being ſmalleſt at the neck, I was under the neceſſity of diſſolving in hot water.

The inſide of the boots and gloves which had been in contact with the wax being by far the ſmootheſt, I made the outſide. The gloves were now finiſhed, unleſs cutting their tops even, which was beſt done with ſciſſars. The boots, however, in their preſent ſtate, more reſembled ſtockings, having as yet no ſoles. To ſupply them with theſe, I poured upon a piece of gunny a proper quantity of milk, to give it a thick coat of gum. From this, when dry, I cut pieces ſufficiently large to cover the ſole of the foot, which, having wet with the milk, I applied; firſt replacing the boot upon the mould to keep it properly extended. By this mode the ſoles were ſo firmly joined, that no force could afterwards ſeparate them. In the ſame manner I added heels and ſtraps, when the boots had a very neat appearance. To ſatisfy myſelf as to their impermeability to water, I ſtood in a pond up to their tops for the ſpace of fifteen minutes, when, upon pulling them off, I did not find my ſtockings in the leaſt damp. Indeed, from the nature of the gum, had it been for a period of as many months, the ſame reſult was to have been expected.

After being thus far ſucceſsful, I was greatly diſappointed in my expectations with regard to their retaining their original ſhape; for, on wearing them but a few times, they loſt much of their firſt neatneſs, the contractions of the gum being only equal to about ſeven-eighths of its extenſion.

A ſecond diſadvantage aroſe from a circumſtance difficult to guard againſt, which was, that if, by any accident, the gum ſhould be in the ſmalleſt degree weaker in one place than another, the effect of extenſion fell almoſt entirely on that part, and the conſequence was that it ſoon gave way.

From what I had obſerved of the advantage gained in ſubſtance and uniformity of ſtrength by making uſe of gunny as a baſis for the ſoles, I was led to ſuppoſe, that if an elaſtic

 cloth,

cloth, in ſome degree correſpondent to the elaſticity of the gum, were uſed for boots, ſtockings, gloves, and other articles where that property was neceſſary, that the defects above-mentioned might in a great meaſure be remedied. I accordingly made my firſt experiment with Coſſimbazar ſtockings and gloves.

Having drawn them upon the wax moulds, I plunged them into veſſels containing the milk, which the cloth greedily abſorbed. When taken out, they were ſo completely diſtended with the gum in ſolution, that, upon becoming dry by expoſure to the air, not only every thread, but every fibre of the cotton had its own diſtinct envelope, and, in conſequence, was equally capable of reſiſting the action of foreign bodies as if of ſolid gum.

The firſt coat by this method was of ſuch thickneſs, that, for ſtockings or gloves, nothing farther was neceſſary. What were intended for boots required a few more applications of milk with the fingers, and were finiſhed as thoſe made with the gum only.

This mode of giving cloth as a baſis I found to be a very great improvement; for, beſides the addition of ſtrength received by the gum, the operation was much ſhortened.

Woven ſubſtances, that are to be covered with the gum, as alſo the moulds on which they are to be placed, ought to be conſiderably larger than the bodies they are afterwards intended to fit; for, being much contracted from the abſorption of the milk, little alteration takes place in this diminution in ſize even when dry, as about one-third only of the fluid evaporates before the gum acquires its ſolid form.

Great attention muſt be paid to prevent one part of the gum coming in contact with another while wet with the milk, or its whey; for, the inſtant that takes place, they become inſeparably united. But ſhould we ever ſucceed in having large plantations of our own vine, or in transferring the American tree (which is, perhaps, more productive) to our poſſeſſions, ſo that milk could be procured in ſufficient quantity for the covering various cloths, which ſhould be done on the ſpot, and afterwards exported to Europe, then the advantages attending this ſingular property of the milk would

would for ever balance its diſadvantages: cloths, and coverings of different deſcriptions, might then be made from this gum-cloth with an expedition ſo much greater than by the needle that would at firſt appear very ſurpriſing; the edges of the ſeparate pieces only requiring to be wet with the milk, or its whey, and brought into contact, when the article would be finiſhed and fit for uſe. Should both milk and whey be wanting, a ſolution of the gum in ether can always be obtained, by which the ſame end would be accompliſhed.

Of all the cloths upon which I made experiments, nankeen, from the ſtrength and quality of its fabric, appeared the beſt calculated for coating with the gum. The method I followed in performing this, was, to lay the cloth ſmooth upon a table, pour the milk upon it, and, with a ruler, to ſpread it equally. But, ſhould this ever be attempted on a larger ſcale, I would recommend the following plan:—To have a ciſtern for holding the milk a little broader than the cloth, to be covered with a croſs bar in the centre, which muſt reach under the ſurface of the milk, and two rollers at one end. Having filled the ciſtern, one end of the piece of cloth is to be paſſed under the bar, and through between the rollers; the former keeping the cloth immerſed in the milk, the latter in preſſing out what is ſuperfluous, ſo that none may be loſt. The cloth can be hung up at full length to dry, and the operation repeated until of whatever thickneſs wanted. For the reaſons above-mentioned, care muſt be taken that one fold does not come in contact with another while wet.

Having obſerved that moſt of the patent catheters and bougies made with a ſolution of the elaſtic gum, whether in ether or in the eſſential oils, had either a diſagreeable ſtickineſs, or were too hard to admit of any advantage being derived from the elaſticity of the gum; I was induced to make ſome experiments with the milk towards removing theſe objections.

From that fluid, by evaporation, I made ſeveral large-ſized bougies of pure gum, which, from their over-flexibility, were totally uſeleſs. I then took ſome ſlips of fine cloth covered with the gum, which I rolled up until of a proper ſize,

and which I rendered solid, by soaking them in the milk and then drying them. These possessed more firmness than the former, but in no degree sufficient for the purpose intended. Pieces of strong catgut, coated with the gum, I found to answer better than either.

Besides an effectual cloathing for manufacturers employed with the mineral acids, which had been long a desideratum, this substance, under different modifications, might be applied to a number of other useful purposes in life; such as making hats, great coats, boots, &c. for sailors, soldiers, fishermen, and every other description of persons who, from their pursuits, are exposed to wet stockings; for invalids, who suffer from damps; bathing caps, tents, coverings for carriages of all kinds, for roofs of houses, trunks, buoys, &c.

This extraordinary vegetable production, in place of being injured by water at its usual temperature *, is preserved by it. For a knowledge of this circumstance I am indebted to the Chinese. Having, some years ago, commissioned articles made of the elastic-gum, from China, I received them in a small jar filled up with water; in which state I have since kept them without observing any signs of decay.

Should it ever be deemed an object to attempt plantations of the elastic-gum vine in Bengal, I would recommend the foot of the Chittagong, Rajmahal, and Bauglipore hills, as situations where there is every probability of succeeding, being very similar in soil and climate to the places of its growth on Prince of Wales's Island. It would, however, be advisable to make the first trial at this settlement, to learn in what way the propagation of the plant might be most successfully conducted. A further experience may also be necessary to ascertain the season when the milk can be procured of the best quality, and in the greatest quantity, with the least detriment to the vine.

* From an account of experiments made with the elastic gum by M. Grossart, inserted in the *Annales de Chimie* for 1791, it appears, that water, when boiling, has a power of partially dissolving the gum so as to render one part capable of being finally joined to another by pressure only.

VI, *Experi-*

VI. *Experiments and Obſervations on Shell and Bone.* By CHARLES HATCHETT, *Eſq.* *F. R. S.* *

SOME experiments which I lately made at the requeſt of Mr. Home, and which he has done me the honour to mention in his ingenious paper on the teeth of granivorous quadrupeds, induced me to turn my attention more particularly to the chemical examination of ſhell and bone, eſpecially as the former appeared to have been hitherto much neglected.

The time ſince theſe experiments were begun, has not been ſufficient to enable me to enter into all the minutiæ of the chemical analyſis of theſe ſubſtances; but, as ſome remarkable facts were aſcertained, I have now ventured to bring them forward, with the addition of ſome obſervations, although as yet the whole is little more than a very imperfect outline.

The firſt of theſe experiments were made on the ſhells of marine animals; and to avoid repetition and prolixity, I ſhall, in a great meaſure, once for all, deſcribe the menſtrua, the precipitants, and the mode of operation.

When ſhells were examined, they were immerſed in acetous acid, or nitric acid, diluted, according to circumſtances, with four, five, ſix, or more parts of diſtilled water; and the ſolution was always made without heat.

The carbonate of lime was precipitated by the carbonate of ammoniac, or of pot-aſh; and phoſphate of lime (if preſent) was previouſly precipitated by pure or cauſtic ammoniac.

If any other phoſphate like that of ſoda was ſuſpected, it was diſcovered by ſolution of acetite of lead.

Bones and teeth were alſo ſubjected to the action of the acetous, or diluted nitric and muriatic acids.

The diſſolved portion was examined by the above-mentioned precipitants; and, in experiments where the quantity of the ſubſtance would permit, the phoſphoric acid was alſo ſeparated by nitric or ſulphuric acid. The phoſphoric acid thus obtained, was proved after concentration by experi-

* From the *Philoſophical Tranſactions for* 1799.

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ments, which being uſually employed for ſuch purpoſes, are too well known to require deſcription.

It is neceſſary moreover to obſerve, that as the ſubſtances examined were very numerous, and my principal object was to diſcover the moſt prominent characters in them, I did not for the preſent attempt in general to aſcertain minutely the proportions ſo much as the number and quality of their reſpective ingredients.

The greater part, if not all, of marine ſhells, appear to be of two deſcriptions in reſpect to the ſubſtance of which they are compoſed. Thoſe which will be firſt noticed have a porcellaneous aſpect with an enamelled ſurface, and when broken are often, in a ſlight degree, of a fibrous texture.

The ſhells of the other diviſion have generally, if not always, a ſtrong epidermis, under which is the ſhell, principally or entirely compoſed of the ſubſtance called *nacre*, or mother-of-pearl.

Of the porcellaneous ſhells, various ſpecies of voluta, cypræa, and others of a ſimilar nature were examined.

Of the ſhells compoſed of nacre, or mother-of-pearl, I ſelected the oyſter, the river muſcle, the *haliotis iris*, and the *turbo olearius*.

Experiments on Porcellaneous Shells.

Shells of this deſcription, when expoſed to a red heat in a crucible during about a quarter of an hour, crackled and loſt the colours of their enamelled ſurface; they did not emit any apparent ſmoke, nor any ſmell like that of burnt horn or cartilage. Their figure remained unchanged, excepting a few flaws; and they became of an opaque white, tinged partially with pale grey, but retained part of their original gloſs.

The ſhells which had not been expoſed to fire (whether entire or in powder) diſſolved with great efferveſcence in the various acids; and the ſolution afterwards remained colourleſs and tranſparent. But the ſhells which had been burned, upon being diſſolved, depoſited a very ſmall quantity of animal coal; and thereby the preſence of ſome gluten was denoted, although the proportion was too ſmall to be diſcovered in the ſolution of the ſhells which had not been burned.

The various ſolutions were filtrated, and were examined by pure ammoniac and acetite of lead; but I never obtained any trace of phoſphate of lime, nor of any other combination of phoſphoric acid.

The carbonate of lime was afterwards precipitated by carbonate of ammoniac; and from many experiments it appeared, that porcellaneous ſhells conſiſt of carbonate of lime, cemented by a very ſmall portion of animal gluten.

Previous to the experiments on ſhells compoſed of nacre, or mother-of-pearl, I examined ſome patellæ from Madeira.

When theſe were expoſed to a red heat in a crucible, there was a perceptible ſmell, like that of horn, hair, or feathers.

The proportion of carbonic matter depoſited by the ſubſequent ſolution was more conſiderable than that of the ſhells above mentioned, and the proportion of carbonate of lime relative to their weight was leſs.

When the recent ſhells were immerſed in very dilute nitric acid, the epidermis was ſeparated, the whole of the carbonate of lime was diſſolved, and a gelatinous ſubſtance, nearly liquid, remained, but without retaining the figure of the ſhell, and without any fibrous appearance.

Theſe ſhells evidently, therefore, contain a larger portion of a more viſcid gelatinous ſubſtance than thoſe before mentioned; but the ſolution ſeparated from the gelatinous ſubſtance afforded nothing but carbonate of lime.

Experiments on Shells compoſed of Nacre, or Mother-of-Pearl.

When the ſhell of the common oyſter was expoſed to a red heat, the effects were the ſame as thoſe obſerved in the patellæ; and the ſolution of the unburned ſhell was ſimilar, only the gelatinous part was of a greater conſiſtency.

A ſpecies of the river muſcle was next ſubjected to experiment. This, when burned in a crucible, emitted much ſmoke, with a ſtrong ſmell of burned cartilage, or horn; the ſhell throughout became of a dark grey, and exfoliated. By ſolution in the acids a large quantity of carbonic matter was ſeparated; and much leſs of carbonate of lime was obtained from a given weight of the ſhell than from thoſe already mentioned.

Upon

Upon immerfing an unburned fhell in dilute nitric acid, a rapid folution and effervefcence at firft took place, but gradually became lefs, fo that the difengagement of the carbonic acid gas was to be perceived only at intervals.

At the end of two days I found nearly the whole of the carbonate of lime diffolved, but a feries of membranes retaining the figure of the fhell remained, of which the epidermis conftituted the firft.

In the beginning the carbonate of lime was readily diffolved, becaufe the acid menftruum had an eafy accefs; but after this it had more difficulty to infinuate itfelf between the different membranes, and of courfe the folution of the carbonate of lime was flower.

During the folution the carbonic acid gas was entangled, and retained in many places between the membranes, fo as to give to the whole a cellular appearance.

The *haliotis iris* and the *turbo olearius* refembled this mufcle, excepting that their membranaceous parts were more compact and denfe.

Thefe fhells, when deprived, by an acid menftruum, of their hardening fubftance, or carbonate of lime, appear to be formed of various membranes applied ftratum fuper ftratum.

Each membrane has a correfponding coat or cruft of carbonate of lime; which is fo fituated that it is always between every two membranes, beginning with the epidermis, and ending with the laft formed internal membrane.

The animals which inhabit thefe ftratified fhells, increafe their habitation by the addition of a ftratum of carbonate of lime, fecured by a new membrane; and as every additional ftratum exceeds in extent that which was previoufly formed, the fhell becomes ftronger in proportion as it is enlarged, and the growth and age of the animal becomes denoted by the number of the ftrata which concur to form the fhell.

Although the *haliotis iris* and the *turbo olearius* are compofed of the true mother-of-pearl, I was induced to repeat the foregoing experiments on fome detached pieces of mother-of-pearl, fuch as are brought from China.

Thefe experiments I need not defcribe, as the refults were precifely the fame.

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I muſt, however, obſerve, that the membranaceous or cartilaginous parts of theſe ſhells, as of the pieces of mother-of-pearl, retained the exact figure of the ſhell or piece which had been immerſed in the acid menſtruum; and theſe membranaceous parts diſtinctly appeared to be compoſed of fibres placed in a parallel direction, correſponding to the configuration of the ſhell.

The ſame experiments were made on pearls; which proved to be ſimilar in compoſition to the mother-of-pearl; and ſo far as their ſize would enable me to diſcern, they appeared to be formed by concentric coats of membrane and carbonate of lime: by this ſtructure they much reſemble the globular calcareous concretions found at Carlſbad, and other places, called *piſolithes*.

The wavy appearance and irradiancy of mother-of-pearl, and of pearl, are evidently the effect of their lamellated ſtructure and ſemi-tranſparency; in which, in ſome degree, they are reſembled by the lamellated ſtone, called *adularia*.

When the experiments on the porcellaneous ſhells, and on thoſe formed of mother-of-pearl, are compared, it appears that the porcellaneous ſhells are compoſed of carbonate of lime, cemented by a very ſmall portion of gluten; and that mother-of-pearl, and pearl, do not differ from theſe, except by a ſmaller proportion of carbonate of lime; which, inſtead of being ſimply cemented by animal gluten, is intermixed with, and ſerves to harden a membranaceous or cartilaginous ſubſtance; and this ſubſtance, even when deprived of the carbonate of lime, ſtill retains the figure of the ſhell.

But between theſe extremes there will probably be found many gradations; and theſe we have the greater reaſon to expect, from the example afforded by the patellæ, which have been lately mentioned.

Some few experiments were made on certain land-ſhells; and in the common garden-ſnail I thought that I diſcovered ſome traces of phoſphate of lime; but as I did not find any in the *helix memoralis*, it may be doubted whether the preſence of phoſphate of lime ſhould be conſidered as a chemical character of land-ſhells*.

Experi-

* Some experiments which I have lately made upon the cuttle-bone of the

Experiments on the covering Subſtance of Cruſtaceous Marine Animals *.

As I was not acquainted with any experiments by which the chemical nature of the ſubſtance which covers cruſtaceous marine animals had been determined, I was deſirous to aſcertain in what reſpect it was different from ſhell; and I began theſe experiments on three ſpecies of the echinus, with which I had been favoured by the Right Hon. Preſident.

I was the more inclined to begin with the echini, becauſe naturaliſts do not appear to be perfectly agreed whether to call them teſtaceous or cruſtaceous animals.

Klein, who has written a work upon echini, after having noticed the various opinions of Rondelet, Rumphius, and others, determines that they are to be regarded as teſtaceous animals. His words are: "Sic plurimas teſtas marinas, in "ſtatu naturali conſideratas, cum echinodermatis potius quam "cum cruſtis aſtacorum vel cancrorum conferre licebit. Ita- "que echinoderma cum Ariſtotele qui echinos inter teſtacea "quibus facultas ingrediendi eſt reponit, nec non cum Be- "lonio, Aldrovando, et excellentiſſimo Sloanio religioſè teſ- "tam appellamus, quam ſatis duram in nonnullis offendi- "mus †."

But Linnæus was of the contrary opinion, as appears from his definition of the echinus: "Corpus ſubrotundum *cruſta* "*oſſea tectum* ſpinis mobilibus ſæpius aſpera ‡."

Now, as the experiments above related had proved that the ſhells of marine animals were compoſed of carbonate of lime, without any phoſphate, I thought it very poſſible that the covering of the cruſtaceous animals might, in ſome reſpect, be different; and if ſo, I ſhould thus, by chemical

the ſhops have proved that the term *bone* is here miſapplied, if the preſence of phoſphate of lime is to be regarded as the characteriſtic of bone; for this ſubſtance in compoſition is exactly ſimilar to ſhell, and conſiſts of various membranes hardened by carbonate of lime, without the ſmalleſt mixture of phoſphate.

* Under this head I have included my experiments upon echini, ſtar-fiſh, crabs, lobſters, &c.

† *Klein Naturalis Diſpoſitio Echinodermatum*, &c. p. 10.

‡ *Syſtema Naturæ.* Edit, Gmelin, p. 3166.

characters,

characters, be enabled to afcertain the clafs to which the echinus was to be referred.

Of the three echini which were examined, one had fmall fpines; the fecond had large obtufe fpires; and the third was of a very flat form.

Portions of thefe echini were feparately immerfed in acetous, muriatic, and diluted nitric acid, by each of which they were completely diffolved with much effervefcence; depofiting at the fame time a thin outer fkin, or epidermis. The tranfparency of the folutions was alfo difturbed by a portion of gluten which remained fufpended, and communicated a brownifh colour to the liquors.

The folutions in acetous and diluted nitric acid were filtrated; after which, from the acetous folution of each echinus, I obtained a precipitate of phofphate of lead by the addition of acetite of lead; and having thus proved the prefence of phofphoric acid, I faturated the nitric folutions with pure ammoniac, by which a quantity of phofphate of lime was obtained, much inferior, however, in quantity to the carbonate of lime, which was afterwards precipitated by carbonate of ammoniac.

The compofition of the cruft of the echinus is therefore different from that of marine fhells; and by the relative proportions and nature of the ingredients, it approaches moft nearly to the fhells of the eggs of birds; which in like manner confift of carbonate, with a fmall proportion of phofphate of lime cemented by gluten.

It remained now to examine the compofition of thofe fubftances which are decidedly called cruftaceous; but previous to this, fome experiments were made on the afterias or ftarfifh, of which I took the fpecies commonly found on our coafts, and known by the popular name of five fingers (*afterias rubens.*)

The afterias is thus defcribed by Linnæus. "Corpus de-"preffum, fubtus fulcatum; crufta coriacea, tentaculis muricata.*"

When the afterias was immerfed in the acids, a confiderable effervefcence was produced, and a thin external ftratum

* Syftema Naturæ. Ed. Gmelin, p. 3160.

was diſſolved; after which it remained in a perfectly coriaceous ſtate, and complete in reſpect to the original figure.

The diſſolved portion, being examined by the uſual precipitants, proved to be carbonate of lime, without any mixture of phoſphate; but in another ſpecies of the aſterias, which had twelve rays (*aſterias pappoſa*), I diſcovered a ſmall quantity of phoſphate of lime. I am therefore induced to ſuſpect that, in the different ſpecies of the aſterias, nature makes an imperfect attempt to form ſhell on ſome, and a cruſtaceous coating on others; and that a ſeries of gradations is thus formed between the teſtaceous, the cruſtaceous, and the coriaceous marine animals.

It was now requiſite to aſcertain if phoſphate of lime is a component part of the ſubſtance which covers the cruſtaceous marine or aquatic animals, ſuch as the crab, lobſter, prawn, and crayfiſh.

Pieces of this ſubſtance, taken from various parts of thoſe animals, was at different times immerſed in acetous and in diluted nitric acid; thoſe which had been placed in the diluted nitric acid produced a moderate efferveſcence, and in a ſhort time were found to be ſoft and elaſtic, of a yellowiſh-white colour, and like a cartilage, which retained the original figure.

The ſame effects were produced by acetous acid, but in a leſs degree; in the latter caſe, alſo, a colouring matter remained, and was ſoluble in alcohol.

All the ſolutions, both acetous and nitric, afforded carbonate and phoſphate of lime, although the former was in the largeſt proportion.

There is reaſon to conclude, therefore, that phoſphate of lime, mingled with the carbonate, is a chemical characteriſtic which diſtinguiſhes the cruſtaceous from the teſtaceous ſubſtances; and that the principal difference in the qualities of each, when complete, is cauſed by the proportion of the hardening ſubſtances relative to the gluten by which they are cemented, or by the abundance and conſiſtency of the gelatinous, membranaceous, or cartilaginous ſubſtance, in and on which the carbonate of lime, or the mixture of carbonate and phoſphate of lime, has been ſecreted and depoſited.

Moreover,

Moreover, as the presence of phosphate of lime, mingled with carbonate, appears to be a chemical character of crustaceous marine animals, there is every reason to conclude that Linnæus did right not to place the echini among the testaceous ones.

The presence of phosphate of lime in the substance which covers the crustaceous marine animals appears to denote an approximation to the nature of bone, which, not only by the experiments of Mr. Gahn, but by the united testimony of all chemists, has been proved principally to consist (as far as the ossifying substance is concerned) of phosphate of lime.

This consideration, therefore, induced me to repeat the above experiments on the bones of various animals.

It is scarcely necessary for me to mention the usual effects of acids on bones steeped in them, as they are known to every physiologist and anatomist.

In every operation of this nature the ossifying substance, which is principally phosphate of lime, is dissolved, and a cartilage or membrane of the figure of the original bone remains; so that the first origin of bones appears to be by the formation of a membrane or cartilage of the requisite figure, which, when the subsequent secretion of the ossifying substance takes place, is penetrated by, and thus becomes more or less converted into the state of bone.

It is also known that the nature of the bone is more influenced by the greater or less predominance of the membranaceous or cartilaginous part than by any other cause. It is not, therefore, for me to add any thing to this part: and in respect to the substance which is the cause of ossification, little also requires to be mentioned; for this (as has been already observed) is known principally to consist of phosphate of lime. I shall only, therefore, briefly mention the result of certain experiments.

[To be continued.]

VII. *History*

VII. *History of Astronomy for the Year* 1799. *By* JEROME LALANDE. *Read at the Lyceum on the 26th of December.*

THIS year will be memorable on account of the total completion of that immense operation respecting the size of the earth, which lasted seven years. Those able astronomers, Delambre and Mechain, who finished it, arrived in the month of November 1798, and by the month of January were able to give us the value of the degrees between Dunkirk and Barcelona. But, as these degrees did not follow an uniform progress, it was soon found, that, to deduce from them the value of the metre, or the new French measure, a discussion was necessary, on the oblate form of the earth, to be adopted. Had they adhered to the arc measured between Dunkirk and Barcelona, they would have had $\frac{1}{150}$, or nineteen leagues, for the flatness at the poles; but, by comparing it with the degree measured under the Equator, they found only nine leagues and a half.

On the 8th of April, after a long discussion, they adopted the latter quantity, and the new metre was determined to be 36 inches 11·296 lines, and the flatness of the earth $\frac{1}{334}$.

On the 5th of May C. Van Swinden, a celebrated Dutch philosopher, made a definitive report on the grand labour of the meridian and the metre, which was afterwards read in a public sitting of the Institute.

On the 22d of June the Institute presented to the two councils the original standards of the metre and kilogramme of platina, which were placed in the magnificent depot of the national archives in the national palace, formerly the Thuilleries.

On the 17th of November the consuls proposed a law to declare that the metre and the kilogramme are the definitive standards of France, and to cause a medal to be struck in commemoration of this grand undertaking. On one side is to be represented the Republic holding the metre and the kilogramme, with this inscription, "To all ages and all nations;" and on the exergue, "French Republic, year 7." The figure will be on a plinth of five centimetres. The reverse will exhibit

hibit the globe of the earth, a pair of compasses extended from the Equator to the Pole, the constellation of the Lesser Bear, and the following inscription—"Unity of measures, ten millionth-part of a quarter of the meridian." The diameter of the medal will be two inches, and will be executed by C. Jouffroy. It was proposed in a report presented to the Institute on the 20th of October, by C. David, Moitte, Leblond Mongez, Laplace, Delambre, Leveque and Gosselin, and was adopted by a law of December 10.

By reducing these measures to the temperature of ten degrees, which is the mean degree of the heat at Paris, and that in the caverns below the observatory, I find the 45th degree to be 57012 toises, instead of 57031 which I had adopted in my astronomy. This is 19 toises less; the mean radius of the earth 3268159 toises, less by 1323 toises than my table, which hitherto has served as a rule in books of natural philosophy. This, without doubt, is very little in regard to the extent of the earth: we are therefore pretty well acquainted with its size, but we are not sufficiently acquainted with its irregularities; and this, at any rate, is one important result from this new labour.

This year has furnished three new comets. On the 6th of December 1798, C. Bouvard discovered, at the observatory, a small one in the constellation of Hercules; it was seen only during six days, and disappeared on the 11th of December in Aquarius, but C. Burckhardt calculated its orbit with all the precision possible*.

C. Mechain, to whom we are already indebted for the discovery of so many comets, found one on the morning of the 7th of August, which is the 90th according to the general catalogue in the third edition of my Astronomy. It was very small and without any tail, but exceedingly clear; it was above the Lynx, in the constellation which Hell formed in 1790, under the name of the Grand Telescope of Herschel. At three o'clock in the morning it had 107° 47′ of right ascension, and 43° 54′ of north declination. It was among the stars which C. Lefrançais observed on the 9th of March 1794, so that very exact positions were immediately obtained.

* Connoissance des Tems, an. 10. p. 389.

C. Mechain

C. Mechain and C. Burckhardt each calculated the orbit with that ardour and readineſs which are natural to theſe able aſtronomers: C. Meſſier followed its progreſs, according to his uſual cuſtom, with indefatigable aſſiduity, for more than two months, till the 25th of October, when it diſappeared on the eaſtern knee of Ophiuchus. During this long appearance our collection of 50,000 ſtars has often furniſhed important points for the reduction of theſe obſervations. On the laſt day it was near a ſtar of the fixth magnitude, the poſition of which I have given in the *Connoiſſance des Tems* for the year 10. All the obſervations of C. Mechain and Meſſier will be publiſhed in detail: ſome of them have a wonderful degree of perfection, becauſe they were made by means of an excellent meridian teleſcope, at the *Maiſon du Champ de Mars* (Military School) by C. Lefrançais and Burckhardt.

This day alſo, December 26, 1799, at half after five in the morning, C. Mechain diſcovered a new comet in Ophiuchus, which will be the 91ſt. It had about 269° of right aſcenſion and 5° of northern declination. It appeared to the naked eye as a ſtar of 5th and 6th magnitude in the teleſcope. Its nucleus was exceedingly luminous, and almoſt bounded: it had a very narrow tail, of a pretty intenſe light, and about 7° in length. It advanced towards the ſouth ſo rapidly that it was apprehended it could not long be obſerved, unleſs it ſhould appear in the weſt after having traverſed a part of the ſouthern hemiſphere.

As the moſt defective part of aſtronomy at preſent is what relates to comets, I muſt recommend them to all our correſpondents. The Bureau des Longitudes has ſent a night teleſcope to C. Flaugergues at Viviers, who has promiſed to make uſe of it.

C. Mougin, in the department of Doubs, has promiſed the ſame thing; but, being a prieſt, he was obliged to quit La Grand 'Combe-des-Bois, where he was curé, and where, ſince 1766, he had made many obſervations and calculations, and had been baniſhed to a hollow valley where he could no longer have a proper view of the heavens. The government has thought proper to ſuffer him to reſume his labours, and

to return to his ancient habitation, which is more convenient for searching out comets.

To render this search more successful, I have proposed to mount a Newtonian telescope in such a manner as to be moveable around the eye-glass, by means of a handle, without changing the place of the eye. M. Von Zach has caused this machine to be engraved, and I hope that, at a more favourable period, it will be executed, and be the means of discovering new comets. If, in the course of forty-three years, the same number has been discovered by searching for them with plain telescopes without any support, how many ought we not to find by the method I propose, which will not suffer the least portion of the heavens to escape observation?

C. Pictet, the celebrated professor of natural philosophy at Geneva, and director of the observatory, has sent us the drawing of an English telescope, which, with a hinge and small arch of copper, becomes parallactic, and proper for following the stars, and for making the greater part of astronomical observations. I hope opticians, who make stands for telescopes, will take advantage of this hint, since mere amateurs, with an achromatic telescope, will thus be enabled, without farther expence, to find out and to follow stars in the open day, and to search for comets, of which we at present stand in need.

The great work on the stars, which I began in 1789, has been carried by C. Lefrançais to nearly 50,000, notwithstanding the unfavourableness of the seasons, which has rendered this year one of the most disagreeable and unfruitful seen at Paris. These stars have been already printed in my *Histoire Celeste*, the first volume of which, as well as my *Bibliographie Astronomique*, will appear as soon as the state of the finances will admit of funds being applied to the printing-house of the Republic. C. Burckhardt has continued to make, with C. Lefrançais, a great number of important observations on the planets and stars; for, as there are two excellent instruments at the Maison du Champ de Mars, these are sufficient to employ those two able astronomers.

Madam Lefrançais has made for the *Connoissance des*

Tems of the year 10, which has just appeared, and that of the year 11, now printing, catalogues of 3000 stars reduced and calculated: she has therefore given us in the whole 10,000. But C. Burckhardt has made tables of a new form, which will enable him to calculate with ease the whole of the 50,000 stars which have been observed.

The obliquity of the ecliptic being one of the fundamental objects of astronomy, we have continued to observe it at the two solstices of this year. We found it in the month of June 5″ more than what is given in my table; but C. Mechain, in the month of December, found it 8″ less than in my table. This difference arises probably from the refraction in winter, which is not yet sufficiently known. This question we hope to resolve in the present year by comparing better the two solstices.

The observatory was in want of good instruments, but we have at length been able to obtain some. The large mural quadrant of C. Lemonnier, which General Bonaparte procured for us, has been erected, as well as that of five feet, which C. Lemonnier lent me in 1751 to observe the moon with at Berlin, and an excellent meridian telescope executed by C. Lenoir, with an object-glass by C. Caroché. The latter made also the large speculum of the twenty-two feet telescope which was at La Muette, and which was equal to that of Herschel of the same length. The telescope of platina, which they wished to take from us, has been secured to the observatory by a decision of the minister of the interior. Thus nothing is wanting to the most beautiful observatory in the world, to render it at the same time the most useful.

We hope at the Peace to have a telescope of forty feet, with specula of platina. On the 7th of August, 7th year, a decree was made by the Institute that the platina we have should be reserved for the large telescope until we obtain from Spain a greater quantity. We have already 200 pounds, but we must procure at least 2000 for the speculum, which the intimate connection between France and Spain gives us reason to hope will be the case.

Mr. Brown, an ingenious optician of London, has made telescopes,

telescopes, the tubes of which always remain horizontal, and in which the image of the object is thrown on the eye-glass by means of a plain speculum.

The Minister of the Marine has augmented the salary of the Astronomers of the Marine at Marseilles, and C. Thulis has resumed his observations with new zeal. The observatories of C. Darquier at Toulouse, Duc-la-Chapelle at Montauban, and Flaugergues at Viviers, have furnished us with many useful observations.

The grand and important work of C. Laplace, entitled *La Mecanique Celeste,* expected with so much impatience, appeared on the 6th of September. In that work will be found the methods and noble analysis which led the author to the important discoveries which I have several times announced and extolled in this history.

C. Burckhardt translated it into German with explanatory notes, at the same time that he read the proofs of the French edition, and went over all the calculations. No author ever had, or was more worthy of having, a translator of so great merit. The *Bureau des Longitudes,* who had long known the zeal and ability of C. Burckhardt, have unanimously elected him to a place vacant three years, though it had been solicited for by several men of letters, of approved talents, and natives of France. But C. Burckhardt has got himself adopted by France; he has preferred it to his own country, which he will no less honour by labouring with us. In the last century, Cassini, Huyghens, Romer, and Maraldi, came in like manner to reinforce astronomy in France; but at that period it had more need of such assistance. There were then only two or three French astronomers; at present we have seven or eight.

M. Schubert has published in German, at Petersburgh, a work on Physical Astronomy in two volumes quarto, in which are found calculations of the perturbations of all the planets.

C. Caussin has finished the translation of the Arabic manuscript of Ibn Iunis. In this work there are more than a hundred observations, thirty of which are of eclipses. I had found a fragment of it among the manuscripts of Joseph de Lisle, my old master.

The Institute decreed, on the 2d of December, that the Minister for Foreign Affairs should be requested to borrow at Leyden the manuscript of Ibn Iunis, in order that the Arabic text might be printed; and we have reason to believe that this request will be granted.

C. Bouvard has calculated the Greek and Arabic eclipses, and found that 3′ 13″ must be added to the anomaly, 8′ 30″ to the secular movement of the anomaly of the moon, and a minute to the supplement of the node for 1790, and that its secular movement must be diminished 2′ 48″.

C. Laplace has determined by theory two equations of the moon. Two long memoirs, transmitted to the Institute in consequence of the prize we proposed, contain many observations and calculations on the same subject. This part of our tables, therefore, so interesting to navigation, has acquired this year a new degree of perfection.

On the 8th of May we observed, for the 17th time, the transit of Mercury over the Sun's disk. It is the first ever completely observed at the descending node, and there will not be another of the same kind till the expiration of thirty-two years. It was impatiently expected by all the astronomers. It was observed throughout all Europe; and C. Delambre has drawn up a work, with new formulæ, in order to deduce from the transits of Mercury all the consequences thence resulting.

C. Vidal, our real Hermophilus, has made at Mirepoix a new series of observations of Mercury in all parts of his orbit; so that we want nothing more in regard to this planet, so difficult to be seen in our climates. This astonishing observer has sent us observations also of more than a thousand austral stars, which can scarcely be seen at Paris on account of their small elevation.

The Ephemerides of Milan for 1799 have furnished us with a new series of observations of Mercury by C. Cesaris. In these I have the pleasure of finding that the errors of my tables are almost insensible. I have had the same satisfaction in regard to the digression of Mercury in his aphelion on the 12th of August. The distance of the sun, and the eccentricity

eccentricity of that planet, were found to correspond with my tables, except a few seconds.

The inferior conjunction of Venus, on the 16th of October 1799, was a phenomenon also of importance for the theory of this planet. It takes place only every eight years in that part of her orbit. It was observed with as much assiduity as success by C. Lefrançais and Burckhardt, in my observatory at the *Maison du Champ de Mars.* I have compared it with that of 1751, which was in the same position, and for which I had made a great number of calculations, and I have found scarcely any thing to be changed in the elements which served for the construction of my tables of Venus, published in the third edition of my Astronomy in 1792. This labour will be inserted in the Memoirs of the Institute.

On the 23d of November this beautiful planet was eclipsed by the moon. This phenomenon would have attracted a number of eyes, had it not been at four o'clock in the morning. Jupiter, which is not so brilliant, drew together a great crowd at the *Palais Royal,* on the 14th of March 1788, to see him on the point of being eclipsed.

Observations of Jupiter have proved that about 30″ are to be added to the tables, which shews that we ought to make a little addition to the mean motion: this I before proved in discussing the ancient observations in the Almagest of Ptolemy. The opposition of the 16th December 1799 gave me 30 seconds. C. Quenot, an able navigator, who has returned from Egypt, observed it with an astronomical circle, and obtained the same result. The latitude also was found too small by 15″; from which I conclude, that the longitude of the node of Jupiter, which is in the tables of C. Delambre, in the third edition of my Astronomy, ought to be diminished 10′.

The tables of Mars are those most deficient. C. Lefrançais, therefore, has been employed on them for some months. He has calculated all the oppositions and quadratures hitherto observed with accuracy, and the result will be tables more accurate than any ever yet given, in which there will be only a few seconds of uncertainty. C. Burckhardt has calculated the perturbations

perturbations of Mars by the action of Jupiter and the Earth, which Schubert and Oriani had before calculated, and without which we could not have hoped to carry our tables to the same degree of perfection.

The collection of observations made at Greenwich by the celebrated Bradley and his assistants between 1750 and 1762 has appeared in England, but I have not yet been able to procure it.

Miss Herschel has published a volume on the stars, not of observations, but researches respecting the grand British catalogue of Flamstead, and the observations of that celebrated astronomer; where she has found 500 stars which are not in the catalogue, as she has found many in the catalogue which are not in the observations.

C. Kramp, Professor at Cologne, has published an analysis of astronomical refractions, in which he has been able to determine the refraction accurately and algebraically without employing any hypothesis or approximation. This work leads us one step farther in this difficult part of astronomy. It was proclaimed, with the other important works of the year 7, at the last exhibition at the Museum.

The Academy of Stockholm has sent M. Swanberg to Lapland to find out the stations which served in 1736 for measuring a degree under the polar circle. He employed himself only in discovering their local situation; but he says he found two minutes error in the reduction of the stations to the horizon, which might have arisen from some defect in the instruments, or from terrestrial refraction. I have been informed in a letter from Sweden, that Maupertuis proposed to recommence the measurement at his own expence. This proves that he was not entirely satisfied with the result, which differs considerably from many other degrees that have been measured. The local inequalities of the ground, however, may have been the cause of this diversity.

C. Desortia, as well skilled in Greek as in Geometry, has made a new translation, with learned notes, of the book of Aristarchus of Samos, respecting the distance of the sun and the moon, collated with ten other manuscripts. This cele-

brated

brated work contains the noblest idea ever formed respecting the manner of finding the distance of the sun from the earth: an idea which, in my opinion, surpasses all those ever entertained by the greatest astronomers. I gave some account of it in the *Journal des Savans* for 1797 *, of which only twelve sheets were published between the 5th of January and the 20th of August.

The Nautical Almanack for 1803 has been transmitted to us by the care of Sir Joseph Banks, President of the Royal Society, to whom we owe this public testimony, that since the commencement of the war he has maintained the intercourse of the sciences. His name, his credit, and his fortune, enabled him to overcome all obstacles, and to remove every political impediment; for we have asked nothing from him which he has not taken the earliest opportunity of granting. The Minister of the Marine renders the same testimony, and acknowledges the favours he has received from Sir Joseph Banks.

Five volumes of the Asiatic Researches have been published at London. They contain a great many observations made by the English in different parts of India; together with memoirs on the Indian astronomy, the lunar year, and the worship of the Indians.

Baron Humboldt has gone to Mexico with instruments and a chronometer by Berthoud, and we hope to receive from him interesting observations respecting the geography of a country almost unknown. He will employ himself also on natural history, a subject with which he is well acquainted †.

C. Nouet published in the *Decade du Caire* several observations made in Egypt; and general Bonaparte has caused them to be reprinted at Paris by Didot. C. Nouet informed me in a letter, that he was going to proceed up the Nile as far as the Tropic, where the famous wells of Syené are situated, and where no shadow is observed in the day of the solstice. We shall therefore have a real geography, ac-

* Page 106 and 203.

† Two letters from M. Humboldt will be found among the Intelligence for this month. EDIT.

companied

companied with other obſervations of thoſe famous countries which gave birth to aſtronomy, and where it has been forgotten for 2000 years.

C. Caſtera has given us, in two volumes 8vo. a tranſlation of the curious travels of Mungo Park into the interior parts of Africa; and we at length know the real direction of the Senegal and the Niger, of which, after ſix months reſearch, I made only one river in my Memoir on Africa, printed among thoſe of the Academy of Sciences for 1790, the laſt volume of that collection.

C. Montucla has given a new edition of his Hiſtory of the Mathematics, enlarged by one-half, and in which aſtronomy occupies a conſiderable place.

In the National Library there has been found a manuſcript on Optics by Ptolemy, which was ſuppoſed to have been loſt. It is a Latin tranſlation from the Arabic. C. Cauſſin, by whom it was found, propoſes to make known this valuable manuſcript.

M. Bode has ſent us from Berlin the remainder of his large and beautiful charts which repreſent the heavens. The great number of ſtars with which I furniſhed him, gave me a right to new conſtellations. To fill up the vacant ſpaces he had put thirty-three animals in the heavens; and I have added a thirty-fourth, *viz.* the Cat, on account of that charming poem, of which Deſherbiers has publiſhed ſome fragments. This new conſtellation of the Cat is between Hydra and the Ship. It has been already engraved in Germany, and will be inſerted in M. Bode's new Celeſtial Atlas, of which he has publiſhed twelve ſheets.

M. Hobert and Ideler, of Berlin, have publiſhed Logarithmic Tables for the decimal ſines, which will facilitate aſtronomical calculations, until the more extenſive tables, which C. Proney cauſed to be calculated at the *Bureau du Cadaſtre*, and which began to be printed ſome years ago, are finiſhed.

The ſtereotype edition of Logarithmic Tables, publiſhed four years ago by Didot and Callet, which ought at length to be free from all faults, has been corrected on the plates, and there is reaſon to think that they approach very near to perfection.

6 We

We wanted alſo ſmall portable tables, and theſe C. Didot has undertaken. I have begun an edition of Logarithms carried to ſix decimal places, like thoſe given by myſelf and Lacaille in 1760, which were publiſhed by Marie in 1768, and reprinted four times afterwards, but ſtill with more faults than the firſt time. We at length, however, have a permanent edition, which it will not be neceſſary to reprint every ten years with more errors than thoſe before diſcovered.

M. Bogdanich, aſſiſtant at the obſervatory of Buda, has made, in ſeveral cities of Croatia, obſervations of great importance to Geography.

[To be concluded in the next Number.]

VIII. *Deſcription of a ſingular Phenomenon in a Thunder-Cloud.* *By* L. C. LICHTENBERG *.

ON a ſummer's day, exceedingly hot and ſultry, the barometer being at 27 inches ſeven lines, and Reaumur's thermometer at $22\frac{1}{2}$, there was formed, about three in the afternoon, to the north of Gotha, a dark thunder-cloud, having the appearance of rocks piled upon each other, and in ſhape almoſt like a muſhroom. (Plate I. Fig. I.) The magnificent ſpectacle exhibited by this immenſe maſs floating in the blue expanſe of the atmoſphere excited my attention; and I ſoon obſerved, that, from the ſmall part which repreſented the ſtem of the muſhroom, there aroſe a fine bright vapour, which in a few moments formed a perfect ring around this part of the cloud. The ring ſeemed to be in violent agitation, by which it became always more enlarged, ſo that in the courſe of a minute it exceeded the greateſt breadth of the upper part of the cloud. It then began to extend itſelf upwards and downwards, and in leſs than thirty ſeconds the whole cloud was enveloped in a tranſparent covering, (Fig. 2.) This phenomenon had ſcarcely continued a minute when the cloud began to extend itſelf, as if by a current of air forced from its interior, and to aſſume the form of a fan. It now loſt its ſmooth rim, which terminated, as it were, in fringes,

* From *Magazin fur das Neueſte aus der Phyſik*, Vol. I.

and the whole acquired the form of a thunder-cloud. Some minutes after, black rainy clouds, formed of the vapour driven downwards, and of the remains of the covering, were collected below; and I expected every moment to ſee the firſt flaſh of lightning, which ſoon followed. A little rain fell at ſome diſtance, but within a quarter of an hour the cloud was ſo diſtended that it was ſoon loſt in a thin miſt. The ſame phenomenon, though not ſo ſtriking, I have ſince ſeen in a great many other thunder-clouds, but inverted. Inſtead of a fine vapour being thrown out, and forming a covering, I ſaw white clouds ſink down, ſpread themſelves out like a veil over the arched part of the cloud, and diſperſe themſelves in it. The reaſon why the vapour thrown out from the cloud here deſcribed formed a ring, was its ſingular form. The vapour, by being forced out on all ſides, was ſo compreſſed that it could extend itſelf only edgeways, and afterwards diffuſe itſelf round the cloud.

If this phenomenon be compared with the electric experiment where a ball of cotton, ſuſpended by a ſilk thread, is introduced into a metal veſſel of a cylindric form and ſufficient width, and where the veſſel is ſometimes rendered electric and ſometimes deprived of its electricity, the idea I mean to convey by this deſcription will be readily conceived. I am of opinion that I can thereby prove that we might examine the electric ſtate of the upper regions of the atmoſphere, and even of the clouds, with accuracy, if the latter were obſerved more frequently than has hitherto been done, and were they employed as natural electrometers for this purpoſe.

IX. *Obſervations on the Elk. By the late* E. H. SMITH, *Phyſician* *.

THE accounts hitherto publiſhed by Naturaliſts, of the Elk and the Mooſe, two very remarkable animals of the deer kind, are confuſed and unſatisfactory. Beſide the miſapprehenſions which they contain relative to both animals, all the difficulties in the way of obtaining juſt notions con-

* From the *American Medical Repoſitory*, Vol. II. No. 2.

cerning

cerning them have been increaſed by the writers of zoology having confounded one ſpecies with the other. Another ſource of error *probably* exiſts in ſome real diſſimilarity between the elk or mooſe of Europe, and the elk and mooſe of North America.

The deſcription of the mooſe-deer by Mr. Dudley, (Philoſoph. Tranſ. No. 368, p. 165.) I have every reaſon to believe, is correct as far as it goes; but it applies ſtrictly to the mooſe, and not to the elk, which is a different animal.

M. De Buffon (Hiſtoire Naturelle, L'Elan et Le Renne,) appears, in ſeveral places, to have mingled the deſcriptions of both animals, and certainly conſidered elk and mooſe as two names for the ſame creature. And this is the more remarkable, as the ſeveral quotations which he has made from different authors contain manifeſt contradictions; as will be evident to any perſon who has ſeen either the mooſe or the elk *. The reader of M. De Buffon, therefore, will not be ſurpriſed if he obtain no clear notion of the Elan; as it is not probable that the illuſtrious author himſelf had a diſtinct conception of the ſubject of his deſcription.

In Mr. Smellie's tranſlation of Buffon, Vol. VI. p. 357, &c. there are ſeveral additions to the original article. The animal and head of an animal, mentioned by Mr. Allomond, were probably of the mooſe kind.

Dr. Goldſmith (Hiſt. of the Earth and Anim. Nature, art. Elk,) acknowledges the diſcordancy of the various hiſtories of the elk, which he alſo ſuppoſes to be the ſame with the mooſe; and he labours, very ineffectually, to reconcile the deſcriptions of authors. The figure given by him reſembles neither the elk nor the mooſe; and the reader will conclude the Doctor's account with as little ſatisfaction as he appears himſelf to have done, when he ſays, "After all, this animal is but indifferently and confuſedly deſcribed by authors," &c.

* See p. 543, Tome III. p. 2. edit. 8vo. à Paris, 1775. The deſcription (inſerted p. 554 of the ſame edition), copied from the Memoirs of the Academy of Sciences, is of the European elk, and reſembles the mooſe more than the elk of America; to which, however, it bears a greater likeneſs than is obſervable between this laſt and the mooſe.

The

The confusion and contradictions of preceding writers have been supposed to be avoided or removed by the celebrated Mr. Pennant in his Arctic Zoology; a work to which those who are better able to judge on such subjects than I am, ascribe transcendant merit. In this work (Vol. I. p. 19, art. Moose,) the author pronounces "the elk and the moose (to be) the same species; the last derived from *Musu*, which, in the Algonkin language, signifies that animal." And this opinion seems to have been quietly acquiesced in; and the substance of Mr. Pennant's account has been copied into the Encyclopædia Britannica, and perhaps into other works of equal credit and circulation.

An opportunity having been presented to me, of satisfying myself that Mr. Pennant has erred in describing the moose and elk as a single animal, I think it my duty to correct this mistake of that learned and amiable naturalist; and I am too well convinced of his love of truth and ardour for the advancement of natural knowledge, to doubt of his receiving my correction with candour and delight. It may be proper for me to premise, that, from the best information that I can obtain, (and I have had occasion to converse with several persons who professed to be well acquainted with both the elk and the moose,) the history which has been given of the moose by that gentleman is essentially just in every other respect than what relates to its identity with the elk.

IN August and September 1797 I visited repeatedly, in company with Dr. Mitchill, Dr. Miller, Mr. Dunlap, and other gentlemen of my acquaintance, four elks, then exhibited in this city for gain. Two of them were males, which the keeper assured us were but two years and a few days old; one a female, somewhat more than three years of age; the fourth a male fawn, a year old. They were taken separately, a few days after their birth, and had been reared by men for the purpose above mentioned. They were very docile, and might be handled and examined with perfect safety.

Colour.—In this they all exactly resemble each other. In the spring the colour of the hair is reddish; it then changes to a greyish dun (which was its appearance when observed

by

by us); and in autumn, to a grey, which continues through the winter. The rump is of a pale yellowiſh white, the colour extending about ſix or ſeven inches from the tail, on all ſides, and very diſtinct from the general colour of the body. A black ſemicircular line, of unequal width, (from 2 to $\frac{1}{4}$ inches,) ſeparates the white of the rump, on either ſide, from the dun or grey of the body. The forepart or ſhin of the legs, and the noſe, are black. The under-lip is fleſhy, and marked, in all four, in an uniform and peculiar manner. Near the cheek, on each ſide, it is black; and a black ſtripe divides it equally underneath: the reſt is white.—The male has a ſhort mane, about two inches longer than the reſt of the hair on the body. At this time the hair was very ſhort; but in winter it is ſaid to be four inches in length, and the mane ſix, and of the colour of the body. The male alſo has a beard, or covering of hair, under his throat and upon his breaſt, which, though ſhort in ſummer, grows out, in the courſe of the autumn, ſix or more inches beyond the hair of the body; and is then, as now, of a deep black colour. This beard is wanting in the female. The male ſheds it every ſpring.

Head.—The head (as will be ſeen Plate II.) reſembles that of the common deer, and of the horſe, much more than that of the mooſe, and is pointed and handſome. The *neck* is rather long and handſome.

The elk has an oblique ſlit or opening under the inner angle of each eye, externally, of near an inch in length; which is ſaid to communicate with the noſtril *. But this we could not correctly aſcertain by examination, though there ſeems no reaſon to doubt the fact. Something of the ſame kind obtains in the fallow-deer, ſuppoſed to be analogous to the *puncta lachrymalia* in the human head. (See Mr. White's Nat. Hiſt. of Selborn: ſee alſo Encyclopædia, art. *Cervus*.) A like opening is noticed by Sparman, and

* Mr. Campbell, of Richmond, Virginia, informed me, that in the ſkeleton head of an elk, which he had ſeen, the opening under the eye, communicating with the noſtril, was ſo large that the thumb might be eaſily introduced into it.

ſuppoſed

fuppofed by him to anfwer the purpofe of facilitating free refpiration, in the Cervine antelope, (*antelope bubalis* of Pallas.) See Encyclopædia, art. *Capra.*

The ufe of this opening is differently explained by the proprietor of the animals here defcribed. He affures us that the elk poffeffes the power, by ftrictly clofing his noftrils, of forcing the air through thefe apertures in fuch a manner as to make a noife which may be heard at a great diftance; that he has feen the wild animals do this frequently; and that the defign of it is to alarm each other when they fufpect any danger near. He has taught thofe in his poffeffion to make a fimilar noife; but it was too feeble to caufe any obfervable dilatation of the flit.

If the above explanation of the keeper of thefe elks be juft, it will probably lead us to a more accurate notion of a circumftance related concerning the *Rupri Capra*, or Chamois of the Alps, of whom it is faid, that "when he fmells or hears any thing which he cannot fee, he *whiftles*, or *blows*, with fuch force that the forefts and rocks re-echo with the found."—See Encyclopædia, art. *Capra.*

Horns.—The female has no horns. The appearance of the horns of the fawn exactly refembles thofe on the head of the principal figure (oppofite p. 18.) given by Mr. Pennant.—The males (as the keeper informed us) drop their horns annually, in May, then leaving a pith about four inches in length, which is foon covered and protected by velvet. In eight weeks the horns began to grow again. In the animals we faw, they had been growing about eight weeks. On our firft vifit, the horns were uniformly covered with a fmooth velvet. About ten days after, the velvet was coming off in narrow ftrips, leaving the horns bare. By the middle of September they were entirely free from it. The keeper informed us, that the animals freed their horns from it, when wild, by rubbing them againft trees. Now they derived the fame aid from the pofts, &c. of their ftable; and the proprietor occafionally affifted them. It was obfervable that a fmall oozing of bloody lymph fometimes fucceeded the removal of a ftrip of the covering.

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The horns of the elk, inſtead of being palmated, as are thoſe of the mooſe, conſiſt of three principal diviſions:— 1. The brow antlers, which the hunters call the *altars*; 2. The two middle prongs, called the *fighting-horns*; and 3. The *horns*, properly ſo called. The two firſt retain their ſimplicity, the laſt increaſes in complexity every year. They do not, as thoſe of the mooſe are ſaid to do, acquire a new branch every year; though ſomething analogous actually occurs. When the animal enters his third year, a ſingle prong or point comes out on the inſide of the left horn; the next year, a ſimilar point on the inſide of the right horn; and ſo alternately. Four ſhort points, called *pikes*, were now apparent, one on each brow-antler, and one on each fighting-horn. They ſeldom exceed an inch in length.

The following meaſurements were made of the horns of one of the male elks. They were ſomewhat longer than thoſe of the other, notwithſtanding an inch or two had accidentally broken off from the end of one of them.

	F.	Inch.
Diſtance between the roots or origin of the horns,	0	4.
Brow-antlers - - - -	1	6
Fighting-horns, not meaſured, but about the ſame.		
Longeſt horn - - - -	3	0
From the tip of one horn to that of the other	2	6

I recollect to have ſeen, in the Muſeum of Yale College, New-Haven, Connecticut, ſome years ago, a remarkable pair of horns, ſuppoſed to have belonged to a mooſe or elk. They were not palmated; and though I had not at that time devoted any attention to ſubjects of natural hiſtory, yet, from the general idea which I retain of their figure and compoſition, I am perſuaded that they muſt, at ſome period, have ornamented the head of an elk. If I am right in this particular, it will afford us ſome notion of the ſize to which the horns of this animal attain. The horns in the Muſeum of Yale College, if I do not miſremember, were ſaid to weigh 55 or 56 pounds.

Size.—As the animals now deſcribed had by no means attained their full growth, it is impoſſible to give any preciſe

information concerning it. The meafurement made of them in their prefent ftate are as follow :—

	F.	Inch.
Length of the male, from the tip of the nofe to the tail, along the line of his back, (the males were nearly of a fize,) - - -	7	3
Of the female, (a year older than the male,) -	7	9
Height - - - - -	4	7
Round the girth or belly - - -	5	6
——— the withers - - -	4	10
Length of the head - - -	1	11
———— tail - - -	0	3
From the extremity of one ear to that of the other	2	2
Length of the ear - - - - -	0	9

The brifket of the elk very much refembles that of the ox.

Place and Food.—The elks which were exhibited here were brought from Upper Canada. They are faid to be found in almoft all the back country of the United States, as low down as Virginia. In refpect to food, as thefe had been domefticated from infancy, nothing particular could be learnt from them concerning what they moft affected in the wild ftate. What appeared remarkable to us was, that they all ate tobacco, as varioufly prepared by the tobacconift, with greedinefs. This, the proprietor affured us, was a natural appetite; and that the wild elks ate the wild plant. We thought that this required further evidence; notwithftanding, we are informed by Haffelquift, that the *Cervi Capra* of Barbary " loves the fmoke of tobacco, and, when caught alive, will approach the pipe of the huntfman, though otherwife more timid than any animal." Encyclopædia, art. *Capra.*

Young.—The rutting-time is from about the 20th of September to the 1ft of October. The female goes about nine months; generally brings forth twins; and it feldom happens but that one is male and the other female.

Gait, &c.—The hoofs of the elk are very much cloven, and, like the moofe and rein-deer, he makes a great clattering with them in travelling. He is very fleet. A ftranger, who was viewing thefe elks at the fame time with us, told

us,

us, that he had feen elks ufed in fleighs the laft winter; and that they were eafily managed, very ftrong, and very ferviceable. He reprefented them as travelling at the rate of 18 or 20 miles an hour. It is poffible that it was the rein-deer that he faw ufed in this manner in Canada.

Flefh and Skin.—The flefh is faid to be excellent, and the fkin employed for various ufeful purpofes.

Oil-Spring.—On the outfide of each hind leg the elk has a fmall veficle or bag, which contains a thin unctuous fubftance that the hunters call *oil*, and the bag the *oil-fpring*. The male is faid to open this, by means of his horn, as the horns begin to grow; when the oil fpreads over the young horn, and is fuppofed to nourifh and protect it. This he does regularly, the keeper informed us, at 10 P. M. and at 4 A. M. The female has not been obferved to make any ufe of this oil, except when wounded. She then, it is faid, opens the bag with her tooth, and applies the oil, by means of her tongue, to the wound.

In rutting-time the elk is reprefented as contriving to throw his urine upon this veficle; which inflames in confequence, and emits a ftrong fcent, whereby the animals difcover each other in the woods. With regard to the fuperftitious notion concerning the elk's curing himfelf of the epilepfy by means of his hind hoof, &c. (See Pennant's Arctic Zoology, art. Moofe,) may it not be probable that the belief originated from the ufe he makes of the oil-fpring, of which the earlieft European writers might be ignorant?

X. *Extract from a Letter of Mr.* J. TURNER *to Dr.* PEARSON, *on the Practice of the Vaccine Inoculation among Country-People.*

I AM informed by our dairy-people, that the cow-pock is epi-bootic chiefly in the fpring among cows about April or May, and that the fpurious forts prevail in common at almoft every other time; and as the fpring is now advancing, I fhall have it in my power to affift you. Believe me, Sir, that the cow-pock mania is as great in the country as in the metropolis.

 Perhaps

Perhaps you would like to know how we carry on the vaccine inoculation: almoſt every cobler, ſhepherd, and cow-boy, are conſummate and experienced adepts in this new ſpecific art.

I will, with your leave, interſperſe this with a remark to ſubſtantiate what I mean to advance.—At Steeple Claydon, a village five miles from Winſlow, great numbers have been inoculated for the vaccine diſeaſe by the moſt illiterate of all beings in human ſhape—the cow-boys and ſhepherd's boys, without any prior or ſubſequent medicine whatever. At Weſtbury, Shenley, Fattenhoe, and a number of villages round our neighbourhood, the ſame. At Finmere, Mr. Holt, the clergyman, (a neighbour of ours,) does adminiſter ſome little medicine, ſuch as ſalts, &c.—People are inoculated, and inoculate themſelves, indiſcriminately; ſuch as farmers, dairy-people, &c. with impunity, without any preparation, ſubſequent purification, or making application to any medical perſon whatever. Yeſterday I ſaw a man inoculate a family with a cobler's awl dipped in another's arm: others do it with a penknife ground like a lancet point: others with needles infected with the vaccine matter. I am a great advocate for the vaccine inoculation: I acknowledge it to be a great acquiſition and diſcovery, and conſequently ultimately a great bleſſing to the community at large, and do not doubt of its ſucceſs.

The well-atteſted facts that you and others aſſert, prove it indubitably; but greatly do I lament that ſome deluſion, or ſome ſecret myſterious means have not been *put in force* to prevent its being in other hands than medical men. The ſmall-pox inoculation is now rapidly declining, and probably in a few years may be known no more. I am ſorry to ſay, that ſome of our ruſtics appear to underſtand the cow-pock better than many of our country medical fraternity. I may add, Farewel, Thiſtle Foreſt! Farewel, Primroſe Hill, Stanton Houſe*, &c.

N. B. The proprietors of the above houſes deny the vaccine diſeaſe to be a ſpecific for the variolæ; but the inter-

* The houſes alluded to are ſmall-pox inoculation houſes, of great repute.

pretation

pretation is obvious, becaufe the new inoculation will not fupply them with patients.

I was treated with fome derifion the other and am every day: a perfon faid, that, as he had inoculated many for the cow-pock, he knew the complaint, and its treatment, better than myfelf.

I am greatly forry the difeafe above fpoken of is fo well known among the cow-people, as many eminent men will lofe great fums in the year by the fmall-pox being fuperfeded.

Query, Whether Fame, with her babbling tongue, fome future time, may not convey ruftic vaccine intelligence to fome metropolitan friends, and fo overturn your excellent Inftitution, which, I am informed, is on the tapis*?

Dear Sir, believe me,

With the greateft deference and refpect,

Your moft humble Servant and Pupil,

Winflow, Bucks. J. TURNER.

XI. *Extract of a Memoir on Elasticity.* *By* C. BARRUEL†.

THE author of this memoir endeavours to explain the caufe of the elafticity of bodies by the help of caloric. After laying it down as a principle, that this fluid is eminently elaftic; that it is interpofed between the integrant moleculæ of bodies, which is proved by their porofity; he hopes, from thefe two principles, to deduce confequences leading to this refult. But whatever may be affigned as the caufe of elafticity, caloric, at any rate, has a great fhare in the phenomena which it exhibits.

The different fyftems adopted by philofophers refpecting the caufe of elafticity, are, in the author's opinion, either vague or evidently erroneous. It cannot, he thinks, be afcribed to a repulfive force, with which the moleculæ are endowed, and which increafes as they approach; for the

* It appears, by the vaccine inoculation in the country, that medical affiftance was fcarcely neceffary.

† From the *Annales de Chimie*, No. 97.

 exiftence

existence of this force is merely hypothetical. Nor can it be said that the elasticity is owing to air interposed between the moleculæ, since the phenomena of elasticity manifest themselves in vacuo.

C. Barruel is of opinion, that if we should ascribe the cause of elasticity to caloric, this question would remain to be answered, Why is caloric so eminently elastic? We know, indeed, says he, that the affinity of moleculæ of water to those of sponge, into the pores of which they introduce themselves, produces an increase of the volume of that sponge; but the cause of the reciprocal attraction of these different moleculæ remains unknown. Besides, we could not refuse to admit that the elasticity of caloric would arise from the property which the moleculæ of this fluid might have of repelling each other: a property the more probable, as it is observed in the electric fluid, with which caloric has so great an analogy. In a word, we may be satisfied with admitting its elasticity as a fact from which we set out, as from an incontestible principle.

The author then proceeds immediately to his object, and examines in what manner caloric acts upon bodies. It dilates them by means of a reciprocal affinity between it and their moleculæ. These affinities are variable; but it is certain that, in regard to the same substance, they decrease in proportion as the distances increase, and that their action is at length reduced to zero.

Now, if we suppose a given quantity of caloric inclosed in a receiver incapable of acting on this fluid, it will every-where diffuse itself in an uniform manner. If we then introduce a molecule of matter, the caloric will be unequally condensed around it, in virtue of the unequal action which it exercises on the parts of the fluid at different distances from it, and it will be surrounded by a kind of igneous atmosphere, composed of strata of different densities. If a second molecule be introduced, the same effects will take place, and every thing will remain in the same state as long as the molecules are at a distance from each other equal to the diameter of their atmospheres; nothing is changed but the temperature. But when the moleculæ are brought so near each other that their

their distance is less than that diameter, their atmospheres will be compressed, and the parts in contact will assume more density and a higher temperature, and which is not in equilibrium with that in the rest of the receiver. These parts deprive themselves of a portion of their caloric, which is distributed among the other strata of these atmospheres until the equilibrium is restored.

When the moleculæ are made to approach each other gently, the compression of the atmospheres and their re-establishment take place peaceably; but if the moleculæ are brought into contact abruptly, the caloric is disengaged with the greatest violence. It is to this rapid disengagement of caloric, strongly compressed, that we ought to ascribe the detonations of the super-oxygenated muriat of pot-ash and of gun-powder.

The moleculæ assumed, for example, retain a portion of the compressed caloric as long as they obey the force which makes them approach each other. When they arrive at that distance at which they exercise an action on each other, their attractive force is greater or less than that with which their atmospheres tend to recover their former state. If the moleculæ, then, be left to themselves, in the first case the system retains its present state; in the other case it will resume its primitive state; and it is in this that the greater part of the phenomena of elasticity seem to consist. This reasoning may be applied to every body, the moleculæ of which are separated from each other by a certain quantity of caloric.

C. Barruel pays attention also to the circumstances under which the elasticity of a body may be manifested, and to the means proper for increasing or producing this property. These circumstances are, compression, a sudden shock, and flexion. In either of these circumstances it happens that the adherence of the moleculæ either is or is not overcome. In the first case the moleculæ are put out of their sphere of activity, and the body is said to be brittle. In the second case the body is flexible, but the caloric interposed between its moleculæ withdraws, or does not withdraw itself, from compression. If it withdraws itself, there is only one dis-

placement of the particles of the body, which is then said to be ductile. If it cannot withdraw itself, it yields or resists. When it yields, the body is soft; when it resists compression, it experiences the effects of it as long as the moleculæ are compressed; it then tends to recover its former state; and this is what renders bodies elastic.

There is no body perfectly soft, ductile, or elastic. Nature presents none which under compression does not suffer a portion of caloric to escape. Thus a body is never perfectly elastic, because the quantity of caloric compressed, being less than the total quantity, cannot restore itself with the same force as if this fluid had remained in its entire state, and cannot keep the moleculæ of the body separated at the same distance as before compression. Besides, the velocity with which it restores itself is also less than that which produced the compression, for a part of this velocity has been destroyed by the entire mass of the compressed body.

A body is more flexible according as it contains more caloric between its moleculæ. This very compressible fluid permits concave moleculæ to approach each other without the convex moleculæ being obliged to separate from each other, as if there were not caloric interposed between them.

The preceding observations may serve to throw some light on various phenomena of elasticity. A blade of copper not hammered evidently remains in that state into which it is put by bending, because the moleculæ of the concave part express, by approaching each other, that portion of caloric which adheres least to them. The other portion, which does not escape, is indeed compressed; but the excess of the spring is compensated by the excess of the adherence of the moleculæ brought together: the body remains in that state in which it is placed.

If the blade has been hammered, it loses by that operation a portion of caloric; the other portion remains compressed; and, when this blade is bent, the compression of the fluid is increased. The excess of spring which it acquires is not counterbalanced by the excess of the adherence of the moleculæ: it tends to restore itself; and the body passes to that state which is called *elastic*.

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The compression and re-establishment of caloric may serve to explain also the oscillations of the moleculæ of a tube of glass terminated by a ball of the same nature, when rubbed with a moistened sponge in order to obtain from it acute tones. The moleculæ of the tube having, by the extension which it experiences, quitted the position proper for their equilibrium, tend to return to it; and as by the velocity acquired they go beyond the term from which they set out, the interposed caloric is compressed, it re-establishes itself with a force equal to the compression, and repels the two parts of the tube to the distance at which they were at first, which occasions an oscillatory motion until it has been destroyed by the resistance of the air.

We might, strictly speaking, explain, without the intervention of caloric, the elasticity of the string of a violin, or of a bell, put into vibration: but from what has been said, it seems to act the most conspicuous part.

Elasticity manifests itself with less energy in liquids than in solids, and yet the former contain more caloric. The reason is plain; it is because their moleculæ, being exceedingly moveable, they can easily withdraw themselves from the compressing forces; but they are elastic, since they have the property of transmitting sounds, and of recoiling back on themselves.

It must have been remarked, that the accumulation of caloric diminishes the spring of solid or fluid bodies: in gaseous bodies, on the other hand, this elasticity is increased by the accumulation, because these bodies, being held in solution in the caloric, participate in its mechanical properties, and chiefly its elasticity.

To increase or produce elasticity in certain bodies, we must employ means proper for bringing together their moleculæ, and keeping the caloric in a state of great compression. The harder, therefore, that a body is, provided it is not so in the extreme degree, the more it will be elastic. It becomes, indeed, less flexible; but this inconvenience may be remedied by rendering the body thin, since its moleculæ will then be less displaced during flexion. There are two things, then, to be considered in elasticity; the rapidity of the

the diſplacement of the parts put in motion, and the extent of the diſplacement, which depend on flexibility.

Allaying and tempering favour the increaſe of elaſticity; becauſe, theſe operations, by bringing the moleculæ nearer to each other, compreſs the caloric, which tends afterwards to re-eſtabliſh itſelf. All theſe facts have induced the author to conclude, that caloric has at leaſt a great ſhare in all the phenomena exhibited by elaſticity.

XII. *On the Efficacy of Yeſt in the Cure of thoſe Diſeaſes known by the Name of Putrid* *.

A Remedy, which contains much fixed air, has been lately ſtarted by the Rev. Mr. Cartwright, which merits the higheſt attention. Seventeen years ago, ſays this gentleman, I went to reſide at Brampton, a very populous village near Cheſterfield. I had not been there many months before a putrid fever broke out among us: finding by far the greater number of my new pariſhioners much too poor to afford themſelves medical aſſiſtance, I undertook, by the help of ſuch books on the ſubject of medicine as were in my poſſeſſion, to preſcribe for them. I early attended a boy about fourteen years of age, who was attacked by this fever; he had not been ill many days before the ſymptoms were unequivocally putrid. I then adminiſtered bark, wine, and ſuch other remedies as my book directed. My exertions, however, were of no avail; his diſorder grew every day more untractable and malignant, ſo that I was in hourly expectation of his diſſolution. Being under the abſolute neceſſity of taking a journey, before I ſet off I went to ſee him, as I thought, for the laſt time, and I prepared his parents for the event of his death, which I conſidered as inevitable, and reconciled them in the beſt manner I was able to a loſs which I knew they would feel ſeverely. While I was in converſation on this diſtreſſing ſubject with his mother,

* The contents of this article cannot be too generally known. How many valuable lives are yearly loſt by putrid ſore throats, fevers, &c. which might be ſaved to the community, and to their relatives, if the cure here recommended were generally known and reſorted to! with proper medical aid, however, where it can be had. Edit.

ther, I obſerved in a corner of the room a ſmall tub of wort working; the ſight brought to my recollection an experiment I had ſomewhere met with, of a piece of putrid meat being made ſweet by being ſuſpended over a tub of wort in the act of fermentation. The idea inſtantly flaſhed into my mind, that the yeſt might correct the putrid nature of this diſeaſe, and I inſtantly gave him two large ſpoonfuls. I then told the mother, if ſhe found her ſon better, to repeat this doſe every three hours. I then ſet out on my journey: upon my return, after a few days, I anxiouſly inquired about the boy, and was informed he was recovered. I could not repreſs my curioſity: though I was greatly fatigued with my journey, and night was come on, I went directly to where he lived, which was three miles off, in a wild part of the moors; the boy himſelf opened the door, looked ſurpriſingly well, and told me he felt better from the inſtant he took the yeſt.

After I left Brampton, I lived in Leiceſterſhire: my pariſhioners being then few and opulent, I dropped my medical character entirely, and would not even preſcribe for any of my own family. One of my domeſtics falling ill, accordingly the apothecary was ſent for; his complaint was a violent fever, which in its progreſs became putrid: having great reliance, and deſervedly, on the apothecary's penetration and judgment, the man was left ſolely to his management. His diſorder, however, kept daily gaining ground, till at length the apothecary conſidered him in very great danger; at laſt, finding every effort to be of ſervice to him baffled, he told me he conſidered it as a loſt caſe, and that, in his opinion, the man could not ſurvive four-and-twenty hours. On the apothecary thus giving him up, I determined to try the effects of yeſt. I gave him two large table ſpoonfuls; in fifteen minutes from taking the yeſt, his pulſe, though ſtill feeble, began to get compoſed and full. He in thirty-two minutes from his taking the yeſt was able to get up from his bed, and walk in his room. At the expiration of the ſecond hour I gave him a baſon of ſago, with a good deal of lemon, wine, and ginger in it; he eat it with an appetite: in another hour I repeated the yeſt; an hour afterwards I gave the bark as before; at the next hour he had food; next he

had another doſe of yeſt, and then went to bed; it was nine o'clock. I went to ſee him the next morning at ſix o'clock; he told me he had had a good night, and was recovered. I, however, repeated the medicine, and he was able to go about his buſineſs as uſual.

About a year after this, as I was riding paſt a detached farm-houſe at the outſkirts of the village, I obſerved a farmer's daughter ſtanding at the door, apparently in great affliction; on inquiring into the cauſe of her diſtreſs, ſhe told me her father was dying. I diſmounted, and went into the houſe to ſee him. I found him in the laſt ſtage of a putrid fever; his tongue was black, his pulſe was ſcarcely perceptible, and he lay ſtretched out, like a corpſe, in a ſtate of drowſy inſenſibility. I immediately procured ſome yeſt, which I diluted with water, and poured it down his throat. I then left him, with little hopes of recovery. I returned to him in about two hours, and found him ſenſible, and able to converſe. I then gave him a doſe of bark; he afterwards took, at a proper interval, ſome refreſhment: I ſtaid with him till he repeated the yeſt, and then left him, with directions how to proceed. I called upon him the next morning at nine o'clock, and found him apparently well walking in his garden: he was an old man, upwards of ſeventy.

I have ſince adminiſtered the yeſt to above fifty perſons labouring under putrid fevers, and, what is ſingular, continues this benevolent clergyman, "I have loſt not one patient."

Dr. Thornton, whoſe opportunities have been great in putrid fevers, having the ſuperintendance of a diſpenſary * which includes the poor of nine pariſhes, and is ſituated in the vicinity of St. Giles's, has made frequent trials of yeſt, and ſpeaks highly in its praiſe.

One day, ſays the Rev. Mr. Townſend, by accident, as Dr. Thornton went paſt a ſhop † in Tottenham-Court Road, he heard the ſcreams of a mother who was agoniſed on ſeeing her child, as ſhe thought, expire. Theſe ſcreams renewed the ſtruggles of the child, and the nurſe who attended threatened to take away at this moment the child, that it

* The General Diſpenſary. † Mr. Burford's.

might

might die in quiet. Dr. Thornton got down immediately ſome tartar emetic, which quickly acted as a vomit; and after the operation was over he gave rhubarb, which cleared the inteſtines; he then ordered the child, every two hours, yeſt and water, with wine and bark, and in three days the dying child was up and well.

The infection had ſpread to two others in the ſame houſe; in this child, and in another, the putrid fever was attended with ſwelled glands, which ſuppurated, and threatened gangrene: in a robuſt ſervant girl it took the form of a dreadful putrid ſore throat; ſhe had an emetic, and afterwards ſome rhubarb, then yeſt and water every two hours. The firſt effects of this newly diſcovered remedy was that of rendering the pulſe fuller and fifteen beats leſs in a minute, and her black tongue ſoon aſſumed a clean and red appearance: without bark or wine ſhe was ſpeedily recovered.

In Dr. Beddoes' Conſiderations there are the following cures:—Mr. Caldwall, engraver, (as Dr. Thornton reports,) requeſted him to go into Green-ſtreet, Leiceſter-Fields, to attend Mr. Hadril, who, he ſaid, it was ſuppoſed would not outlive the day. I found him labouring under a dreadful putrid ſore throat, the tongue was black and thick coated, and the pulſe quick and fluttering; evacuations being firſt premiſed, yeſt and bark in porter were exhibited every two hours: his ſiſter, who nurſed him, was ſoon after attacked by the ſame fever, but the throat was not affected. She was not like her brother confined to her bed, but her weakneſs was ſo great that ſhe could not walk acroſs the room, nor even ſtand up half a minute without ſupport. In both theſe caſes the relief from the yeſt was very ſtriking, and they were ſoon cured: the wife was alſo infected, who received a ſimilar benefit from the yeſt.

The moſt extraordinary caſes, however, are the following: —In Huſband-ſtreet, a ſmall confined ſituation near Berwick-ſtreet, a fever broke out, which in the ſhort ſpace of a fortnight, in three houſes only, ſwept away ſix perſons. Dr. Thornton's aſſiſtance was at this time called in to Mrs. Wollot, No. 1, in that ſtreet, who lay delirious and comatoſe, with her two children, all in the ſame bed. She re-

I 2 fuſed

fufed medicine and food, and was obliged to be drenched in order to get either down: an emetic and cathartic being premifed, they were all put upon the fame plan; that is, were to take, every three hours, two-thirds of a glafs of frefh porter, with two table fpoonfuls of yeft and the juice of half a lemon; and the food at intervals was the white of eggs, which Dr. Thornton judged of all things were leaft fubject to putrify *, beat up with fome fugar and water, and, as it was the commencement of fummer, ftrawberries were alfo ordered; and without any farther medicine from the apothecary than the emetic and purge, although the woman was at firft obliged to be drenched, yet fhe and her whole family recovered, and this very rapidly.

Among the poor in St. Giles's nothing is adminiftered by Dr. Thornton, after cleanfing the primæ viæ, than two table fpoonfuls of yeft in fome porter every two hours; and out of above forty cafes not one has died under this treatment.

XIII. *On the various Effects produced by the Nature, Compreffion, and Velocity of the Air ufed in the Blaft-Furnace. By Mr.* DAVID MUSHET, *of the Clyde Iron-Works. Communicated by the Author.*

WHEN it is confidered that in the fmelting operation the reduction of immenfe quantities of materials is effected by a compreffed current of air impelled by the whole power of a blowing machine, the confequences of the change of air, either in quantity or quality, muft be very obvious: when, farther, we contemplate the metal called into exiftence by means of combuftion thus excited; when we confider iron as having the moft powerful affinity for the bafe of that part of the air which maintains combuftion; and when we view the debafed ftate to which the metal is reduced by coming into improper contact with it, we muft conclude, that the application of blaft in the manufacturing of iron calls for the moft

* We know that eggs are kept for a great length of time, and the white, even under the heat of the hen's body, does not putrify, and it ferves as milk to the embryo in the egg.

most minute and thorough investigation. In order to take a comprehensive view of this subject, the following division will be requisite:—

1st, The intimate connection which the quantity of blast bears to the area of the internal cavity of the furnace, and to the nature of the pit-coal.

2d, The various modes by which air is procured, and how these respectively affect the quality of the air.

3d, The various changes to which air is subjected by a change of temperature in the atmosphere, with the consequent effects.

4th, How far increased or diminished velocity and compression alter the results of the furnace.

5th, The form and diameter of the discharging-pipe.

1st, Then, in the construction of a blast-furnace and blowing-machine, the quantity of air to be used ought to depend upon the internal dimensions of the former; which, again, ought to be formed according to the quality of the pit-coal. Upon the softness or hardness of the coal, ought more immediately to depend the height of the blast-furnace. This necessary precaution has given rise to a vast variety of furnaces, of different capacities, from 30 to 50 feet in height, and from 9 to 16 feet diameter at the boshes. Furnaces from 30 to 36 feet are used for the softer qualities of coal, such as a mixture of free-coal and splint. Furnaces from 36 to 45 are appropriated to the burning of splint-coal cokes; and in Wales, such is the superior strength and quality of the pit-coal, that the furnaces admit of being reared to the height of 50 feet.

These various qualities of coal, it has been formerly shewn, have appropriate weights of iron-stone, and, to use the language of the manufactory, are capable "of supporting a greater or lesser burden of mine." The former qualities admit not of having the air discharged in great quantity, unless it is impelled under an uncommon degree of compression and consequent velocity incompatible with the operations of a steam-engine. The reason is obvious: when air, loosely compressed, or comparatively so, is thrown into a body of ignited fuel, the mechanical structure and continuity of whose particles

particles are soft, the air is much more easily decomposed; the ignition, of course, is more rapid: the descent of the materials is promoted beyond their proper ratio, and long before the carbonaceous matter has penetrated the ore, or united to the metal, to constitute fusibility. I shall adduce an example, as being most illustrative of this doctrine.

Suppose a blast-furnace, 35 feet high, 11 feet wide at the boshes, properly burdened, and producing No. 1, pig-iron. Let the discharge of air be supposed equal to a pressure $2\frac{1}{2}$ pounds upon the square inch, or equivalent to 1-6th of the atmosphere, or 5 inches of mercury: under these circumstances let it farther be supposed, that 1500 cubical feet of air are discharged in one minute; and that the diameter of the discharging-pipe is 2·625, the area of which is equal to 6·890625 circular inches. Let the discharging-pipe be increased to 3 inches diameter, and let the same quantity of air be passed into the furnace; it is evident that as the area of the discharging-pipe is increased to 9 circular inches, or nearly 1-3d more than formerly, the compression of air must be proportionally diminished. This alteration is soon perceived by its effects; the quantity of scoria increases from the furnace, whilst the consumption of the materials above is also considerably augmented. In a few hours the scoria will have undergone a complete change, from pure white, enamelled with various blue shades, to a green, brown, or black colour, considerably charged with the oxyd of iron *. The same effects will continue, in greater or lesser degree, till all the materials are reduced which were existing in the furnace at the period of diminished compression. The philosophy of this fact may be accounted for in the following manner:—

While the just association of proportions remained, the air was discharged under such a degree of compression as to excite proper combustion: the decomposition of the air by means of the ignited fuel, was not effected in immediate contact with the separating metal, but had, by its uncommon degree of density, resisted decomposition in the ignited passage,

* The metal will have lost nearly all its carbon, and have become inferior in value 25 to 30 *per cent.*

fage, and had been decompofed upon the cokes at a greater elevation in the furnace. As a proof of this, we frequently fee a tube formed throughout the whole breadth of the furnace, quite black and apparently cold, formed of the fufed materials; when this is removed, a confiderable defcent momently takes place of cokes heated vifibly beyond the common pitch: thefe inflame rapidly, but are foon again cooled to blacknefs by the inceffant difcharge of air upon them. The defcending mixture of iron and lava are in like manner cooled around the line of blaft; the tube is again formed, and, if not removed, will remain for days together, while the furnace will be otherways working in the beft manner.

When by accident or defign the compreffion and velocity of the blaft are diminifhed, the tube begins to burn, and throws off a great many red fiery-coloured fparks, the fides and roof fail, and are carried before the blaft in all directions. Sometimes confiderable cloats of imperfect iron are recoiled with fuch violence as to efcape the vortex of blaft, and iffue from the tuyre-hole with fuch velocity as to inflame in the air, and fall down in the ftate of oxyd. In the end the tuyre will appear to flame, and all the paffage inwards fhews an aftonifhing degree of whitenefs. The decompofition of the air is inftantaneoufly effected upon its entering the ignited paffage; the iron by this means is expofed to the oxygen that is difengaged; and the vaft quantity of caloric fet free, in confequence of its union with the iron and carbon, produces the aftonifhing heat now vifible, but which formerly took place at a more proper height in the furnace.

From this it will appear, that although a greater apparent degree of heat is vifibly produced by the fudden decompofition of the air, and a more rapid defcent of materials for fome time is the confequence, yet, as the quality of the iron is impaired, and as in the end the furnace will return to its old confumption of materials as to quantity, the effects of a loofe foft blaft are conclufively pernicious.

It fometimes happens, that when a loofe blaft is furcharged with a confiderable portion of moifture, or comes in contact with cokes which had been wet when introduced into the furnace, the inflammation which takes place at the tuyre is prodigious;

prodigious: fine fire-clay will be melted down and blown to flag in a few minutes; the fides of the furnace, compofed of very infufible fire-ftone, is next attacked, and in a few hours will be fo completely deftroyed as to ftop the working, and require immediate repair. Effects fimilar to thofe now defcribed will be felt when blaft is improperly proportioned to coal of a ftronger continuity of fracture and fuperior quality. Befides the effects produced by the fudden decompofition of iron, others of like nature are produced where a foft coal is ufed, a fmall furnace, and a great difcharge of blaft.

It has been found that crude iron, to be properly matured, ought to remain in the blaft-furnace, according to circumftances, 48 to 60 hours; that is, from the period that the iron-ftone is introduced till fuch time as the metal begins to occupy its place in the hearth in a ftate of perfect feparation. When the contrary is the cafe, the mixtures arrive at the hotteft parts of the furnace before the metal has taken up a fufficient quantity of carbon from the fuel; the action of the blaft, and the immediate heat by which the ore is furrounded, forces the iron from its connections to the bottom of the furnace. The quality is de-carbonated, and reduced in its value: to reftore this again, the local portion of fuel is increafed; this adds to the expence of manufacturing, and diminifhes, in fome meafure, the fmelting of the furnace.

When fplint-coal cokes are ufed in the blaft-furnace, the blaft admits of being thrown in under the higheft poffible pitch of compreffion; the uncommon denfity of the charcoal fuftains a very powerful difcharge of blaft before it is diffipated to facilitate the general defcent. Moft frequently, large maffes of thefe cinders pafs through the whole ignited cavity, and are thrown out below, poffeffing all the acutenefs of their original form and fracture.

This quality of coal is ufed in all the Curfon blaft-furnaces, where, to enfure a refpectable produce, the air is difcharged under a preffure equal to $3\frac{1}{4}$ pounds upon the fquare inch, or $6\frac{1}{2}$ inches of mercury.

The fame quality of coal was ufed at the Devon ironworks, where, at one time, having all the blaft of a 48 inch cylinder engine thrown into one furnace, the column of

 mercury

mercury supported was upwards of 7 inches; the quantity of air discharged under such an impelling power, I found to exceed 2600 cubical feet *per* minute.

The coals used at the Cleugh, Cleland, and Clyde iron-works, are nearly of the same quality at each—a mixture of splint and soft coal. The Muirkirk and Glenbuck iron-works have a coal different from any of the former, and in some particular spots it considerably resembles the English clod-coal.

2d, The various methods of procuring air for the blast-furnace may be reduced to the following:—1st, That procured by cylinders, and discharged into the furnace by means of a floating piston heavily loaded, and working in a large receiver or regulating cylinder: 2d, That wherein pumping cylinders only are used, and the air thrown into chests inverted in water, called the *water-vault:* 3d, That mode wherein the air is discharged from the pumping or forcing cylinder into an air-tight house, called the *air-vault.*

The first method is the original mode of blowing, and is still much used at those iron-works whose erection has been prior to the last fifteen years. By this mode the quality of the air is less subject to alteration by a change of atmosphere. The principal objection to this manner of blowing, is the want of capacity in the receiving cylinder; which cannot be increased so much as to take away the considerable intervals which occur at different parts of the engine-stroke. This effect is sensibly seen by the speedy and irregular ascent and descent of the column of mercury. In water blowing-machines, where the air is raised by three or four cylinders worked by means of a crank, where the air is received into an air-chest, and forced into the furnace by the continual action of the blast of each successive cylinder, the current of air is steady, and supports the column of mercury with great uniformity.

The use of the water-vault has of late years become very general among new erected works. Its properties are, a steady and very cold blast: the largeness of the receiving cisterns gives them a sufficient capacity to retain every pound of air

 raised

raiſed by the furnace, and diſtribute it to the greateſt advantage. This is not the caſe with the floating piſtons, where a certain quantity of ſpare wind is thrown out at every return of the engine, leſt the great piſton and weight ſhould be blown out of the cylinder altogether; which, indeed, ſometimes happens. The only objection which remains in force againſt the uſe of the water-vault, is the tendency which it has to take up a conſiderable portion of the water in ſolution, and introducing it into the furnace. A judicious arrangement of the conducting-pipes would in ſome meaſure obviate this, as well as the more dangerous tendency which water has to riſe in a pipe ſpeedily emptied of its air by the ſtopping of the engine: a ſtream of water thus conveyed to the furnace, would be productive of the moſt awful conſequences.

The air afforded by the air-vault is much inferior to that obtained in the former methods. This immenſe magazine of compreſſed air generates a conſiderable portion of heat, which greedily ſeizes the damps, which are unavoidable in underground excavations, and conveys them to the furnace. The blaſt is, however, ſteady and uniform; and when the inſide of the building is completely ſecured againſt the paſſage of air, it is productive of conſiderable effects in the furnace. In the ſummer months, however, the air becomes ſo far debaſed as to affect the quality of the iron, and change it from grey to white. Every change in the temperature of the atmoſphere during this period, is indicated by various changes in the furnace.

The largeſt air-vault hitherto in uſe was excavated out of ſolid rock at the Devon iron-works: the fiſſures of the rock admitted conſiderable quantities of water; and the ſame degree of damp would always prevent the poſſibility of making the ſide-walls and roof air-tight by means of pitch and paper, &c.

Beſides the various natures of blaſt, as to the ſtrength and equality of the current afforded by different modes of conſtructing the blowing-machines, a variety in the quality of the air obtained is alſo an invariable conſequence: this is

ſufficiently

sufficiently known by the effects which it produces in the blast-furnace, and ought to be subject to scrupulous examination.

In this, as in other countries, larger produces of cast iron are obtained in the winter months than during the summer and autumn seasons: the quality of the metal is also much more carbonated, and with a less proportion of fuel. In many parts of Sweden, where the summer heats are intense, the manufacturer is obliged to blow out or stop his furnace for two or three months: not only is he unable to make carbonated metal, but is frequently incapable of keeping the furnace in such trim as to make a produce of any quality whatever. In Britain, during the months of June, July, and August, more especially in dry seasons, the quality of the iron, with the local proportion of fuel, will be depreciated 30 *per cent.*, and the quantity reduced to 2-3ds or 3-4ths.

In seeking for a solution of this universally acknowledged fact, our attention is naturally directed to an examination of the various states of air. That the quality of the air in winter is more fit for combustion than in summer, is a truth which requires no farther demonstration. Greater coolness, whereby an almost complete refrigeration of moisture takes place, and the presence of perhaps a greater relative proportion of oxygen, may account for this phenomenon. On the contrary, the quality of air during the summer months becomes much contaminated for combustion, by holding in solution a much greater quantity of moisture: the abundance of nitrous particles may also diminish the usual proportion of oxygen.

This will account for the inferior effects of combustion both in common fires and in the blast-furnace; it will also in a great measure tend to solve the curious phenomenon of pig-iron taking up less carbon in summer, although reduced with a superior quantity of fuel. The air discharged most probably contains less oxygen; yet the metal is much less carbonated than at other times, when contrary proportions of these exist. Most probably the deficient carbon is carried off by dissolving in hydrogen, forming a constant stream of hydro-carbonic gas, while the oxygen that is set free unites to the iron; and while it reduces its quality, at the same time

the quantity is reduced by a portion of the metal being loſt in the ſcoria *.

To correct theſe occaſional imperfections in the quality of the air, and to deviſe methods to procure air always fit for proper combuſtion, ought to be an object of much conſideration to the manufacturer of caſt iron. Whether ſuch a conſideration has given riſe to the different modes of receiving and diſcharging the air now in uſe, I cannot ſay; I rather think not: a great quantity of air has hitherto been a greater object than a certain and uniform quality; and in a country where there is more temperate and cold weather than hot, it is by far the moſt important object: to unite both, however, would be an attainment of the greateſt utility, and would rank the diſcoverer amongſt the well-deſerving of his country. How far the mechaniſm of our preſent machinery has been adapted to the exigencies of our atmoſphere, will appear upon examining the nature and properties of the air, judged by its effects upon the blaſt-furnace.

The air produced by the blowing and receiving-cylinder is leſs changed, and leſs ſubject to change, than that produced and lodged in contact with a vaſt body of air or water. If the blowing-cylinder is fixed in a dry cool ſpot, the only difference which the air undergoes is an increaſe of temperature; this is ſo very conſiderable, that upon entering the blowing-cylinder immediately after ſtopping the engine, I have found the thermometer riſe 15 to 17½ degrees higher than the ſurrounding air. That this heat is generated in the cylinder is unqueſtionable; but whether it is occaſioned by the friction of the piſton leather upon the ſides of the cylinder, or expreſſed from the air by its ſevere compreſſion, I have not yet been able to decide. It very probably ariſes from both cauſes, although the latter is ſufficient to produce a much greater degree of heat. What effect this increaſe of temperature has upon combuſtion we are unable to ſay, as the degree of heat accumulated will at all times bear a reference to the temperature of the ſurrounding air, and as

* May not the ſuperabundant azote of the ſummer atmoſphere produce part of theſe effects, by diſſolving a portion of the carbon, and forming carbonated azotic gas, as has been proved by M. Lavoiſier?

there

there is no method likely to be devised where heat would not be generated by the action of the particles of air upon each other. When the bulb of a thermometer is held in the middle of the current of blast, as it issues from the discharging-pipe, a temperature is indicated as much lower than the temperature of the surrounding air, as the temperature of the cylinder was higher; and it is most probable that a much lower degree would be obtained, were it not for the previous expression of some heat in the blowing-cylinder. Upon the whole, I think, the quality of the air obtained in this way of blowing uniformly most fit for combustion, provided the numerous pauses and irregularities of the current of air were done away.

Air forced into the furnace under water pressure always contains a considerable portion of moisture; the blast of course is colder, as it issues from the discharging-pipe. The temperature differs so much from that of the external air as to sink the thermometer from 54° down to 28° and 30°. Such effects are produced by air coming into contact with water, that, although the temperature of the atmosphere is 60, 65, to 70, yet the blast at the orifice seldom rises above 38°: the cold produced in this manner is much increased if the air is surcharged with so much water as to be visible in the state of a fine spray. The leading feature, therefore, of the water-vault, as to its effects upon the quality of the air, seems to indicate an almost uniform degree of temperature in the blast: this can only be occasioned by the warm air in summer taking up a greater portion of the water in solution, the escape of which at a small orifice, and under a great degree of compression, produces the very great depression of the thermometer. I have already hinted at the bad effects produced by moist blasts, and shall, in a proper place, more minutely attend to them.

The most inferior quality of air used in the blast-furnace is that thrown into the air-vault, and afterwards expressed from thence by its own elasticity and the successive strokes of the engine. The capacity of such a building is from 60 to 70,000 cubical feet; this, when filled, generates a much superior degree of heat to that sensible in the blowing-cylinder.

As

As this heat is produced many feet diſtant from any mechanical motion, it is moſt evident that it is extricated from the air, and will readily unite with the moiſture which penetrates the building: the quality of the air introduced into the furnace will therefore be in proportion to the quantity of moiſture taken up; this will be much more in ſummer than in winter, as the temperature of the former exceeds that of the latter. The ſenſation, on entering the air-vault in the coldeſt months, immediately after ſtopping the engine, is exactly ſimilar to that experienced upon entering a crowded room in the hotteſt ſummer day; the walls are covered with damp, and the ſuperior regions of the vault readily obſcure the flame of a candle. The feeling, upon remaining in the air-vault when the engine is at work, is leſs marked than would be expected where ſo great a compreſſion of air exiſted; the ſenſe of hearing, owing to the moiſture in the conducting medium, is conſiderably impaired, and reſpiration is performed with ſome difficulty; the light of a candle is faint, and not viſible at the diſtance of a few feet.

XIV. *Some Remarks on the Scotch Diſtillery, and a Deſcription of an improved Still, which may be charged and run off Seventy-two Times in Twenty-four Hours* *.

THE improvements that have taken place in the common diſtillery buſineſs in Scotland within theſe few years are ſuch as cannot fail to excite the wonder of men of ſcience, while they ſerve to prove, at the ſame time, that, to inſure progreſſive improvement in any branch, the moſt effectual mean is that ſtimulus which reſults from intereſt.

It is not neceſſary, and it would be tedious, to deſcribe the progreſs of the diſtillery in Scotland, ſince it firſt began to aſſume a form of ſome conſequence, about twenty years ago. It may, however, not be thought improper to mention what gave occaſion to the licence act being introduced into

* Extracted from the Report of the Committee of the Houſe of Commons, July 1799.

the

the Lowlands of Scotland, by which the manufacture and duties levied on ſpirits in Scotland and in England became regulated by diſtinct and ſeparate laws.

The Scotch diſtillers, previous to the year 1786, had ſent large quantities of ſpirits to the London market, which had occaſioned a reduction of the price; and it was found alſo that the revenue of the diſtillery had diminiſhed. From this circumſtance it was ſuſpected that frauds were committed againſt the revenue to a great extent; and the London diſtillers having received certain information of the manner in which the duties were evaded in Scotland, this ſuggeſted the neceſſity of making ſeparate and diſtinct laws for raiſing the duties in the different kingdoms.

Therefore, in July 1786 the licence act for the Lowlands of Scotland commenced, and was to continue for two years. The principle on which this act was framed, between the contending and rival diſtillers of the two kingdoms, with conſent of the miniſter, was in this manner:—

The duty then paid by the Engliſh diſtillers was ſixpence *per* gallon on the waſh; and ſuppoſing that 18 gallons of ſpirits, 1 to 10 over hydrometer proof, were taken from 100 gallons of waſh, the duty on the ſpirits of that ſtrength amounted to 2*s.* $9\frac{1}{3}$*d. per* gallon. The diſtillers in the Lowlands of Scotland were allowed to work ſtills of any capacity or extent, on paying an annual licence duty of thirty ſhillings *per* gallon on the content of their ſtills; and the ſpirits thus made were to be conſumed in Scotland. They were alſo allowed to ſend their ſpirits into England on paying an additional duty of two ſhillings *per* gallon, of the ſtrength of 1 to 10 over hydrometer proof, when landed there. Thus it was computed, that the annual licence duty of the Scotch diſtillers would be equivalent to the remaining $9\frac{1}{3}$*d. per* gallon paid by the Engliſh diſtillers, on this ground, that the Scotch diſtillers could run off their ſtills only *once* in the 24 hours.

The licence act being ſettled in this manner, and as the Engliſh diſtillers conſidered they had been thus far ſucceſsful in fixing the Scotch to pay a certain duty of 2*s. per* gallon, not to be evaded, they expected to have had the London

market to themselves: but they soon found they were mistaken, and that the Scotch continued to send increased quantities, and the price of spirits fell very low in the London market.

In the beginning of 1788 an investigation took place in a Committee of the House of Commons, respecting the number of times in which the Scotch distillers had worked off their stills in a given time, and it was found that they were in the practice of running off their stills five or six times in the space of 24 hours. It was therefore inferred, that by misrepresentation they had obtained an undue advantage over the English distillers; and in February 1788, before the two years of the licence act had expired, an additional duty of sixpence *per* gallon was laid on all spirits sent from Scotland to England; the remaining 3½*d. per* gallon being reckoned a sufficient equivalent for the licence duty. It must well be remembered, that at this time the Scotch distillers, who had long contended with the English, became bankrupts, and resigned that market to their rivals. Since that time new regulations have been made, by which the whole of the English duty is paid on the Scotch spirits when landed in England; and the revenue arising from the distillery has very much increased.

Having endeavoured briefly to mention the causes which originally occasioned the licence act to be introduced into the Lowlands of Scotland, it may now be proper to observe, that the ingenuity of the distillers, working by the licence act, has constantly been excited, and always successful in lessening the duties, their success having kept pace almost in the degree in which the duties have been increased. For, when the licence act commenced in 1786, the distillers continued for some time to use stills of a large size, and the duty being only 30*s. per* gallon on the content of the stills, they did then work them off five or six times in the 24 hours; by which the duty cost from 2*d.* to 3*d. per* gallon on the spirits. In 1788 the duty was increased to 3*l.*, and it continued at that rate for about five years: during this space they improved in running off their stills to about 20 times in the 24 hours. They attained to this degree of dispatch by greatly reducing the size of their stills, and enlarging their furnaces.

At

At this time the duty on the fpirits did not coft them above one penny *per* gallon, which being very fmall they did not think any farther improvement neceffary.

Since the commencement of the prefent war, the minifter has thought that to lay an additional duty on fpirits made in Scotland would be a proper meafure; and in 1793 the annual licence duty on the ftills was increafed to 9*l.*, and in 1797 to 54*l.* *per* gallon, which is the prefent duty. He had reafon to expect that a large increafe of revenue would arife from this high duty; and yet it muft appear very furprifing that the revenue from the Scotch diftillery has not increafed in any confiderable degree. This is not owing to a diminution in the confumption of fpirits; for, the price of that article being fo low in December laft as 3*s.* *per* gallon, there can be no juft reafon to think that a lefs quantity has been ufed.

When the diftillers found the duty raifed on them fo high as 54*l.* *per* gallon, they tried every expedient in order to accelerate the procefs. From repeated experiments they have found, that the more fhallow the ftills are made, and the bottoms enlarged, the more they can increafe the fize of the furnace, and apply a larger quantity of fuel, and confequently bring the wafh in the ftill to boil in a fhorter fpace of time. The liquor in the ftill being likewife on a more extended furface, the evaporation or procefs of diftillation is performed in a more expeditious manner. It is principally by the fhallownefs of the ftills that the Lowland diftillers are now enabled to run off their ftills three times in the hour, or feventy-two times in the 24 hours; a degree of difpatch which a few years ago was thought to have been impracticable.

Plate III. is a reprefentation of one of the common flat ftills* now ufed by the Scotch diftillers. A reprefents the afh-pit; *b*, the grate; *c*, the furnace-door; *d*, the flame paffing on towards the flue; and *e*, the body of the ftill; *f*, the bottom and fide-fcraper, an apparatus which is made to revolve continually during the procefs by means of an upright fhaft *g*, driven by machinery, and which paffes through a cup-mouthed aperture *h*. This is made fteam-tight by means

* Other improvements have been introduced, of which we fhall give fome account in a future Number.

 of

of wool and greafe, held down by a plate of metal faftened by fcrews. *i* is a plate of copper, concave, or rather conical below, ftretching almoft to the fide of the ftill; *m* a large hole in the centre of this plate, through which the fteam generated at the bottom of the ftill efcapes into the head. This plate, being made of quick afcent, facilitates the efcape of the fteam, which might otherwife be partially accumulated under the fhoulder of the ftill, and, by its re-action on the fubcumbent liquor, caufe the ftill to run foul, or boil over. *k k* the head of the ftill. To the fcraping-machine *f* are attached chains, which, by the rotary motion of the fcraper, are dragged with rapidity over the whole of the bottom, by which means the wafh is prevented from burning to the bottom, and thereby generating any new compound injurious to the flavour or quality of the fpirit. Thefe ftills are ufually of from 40 to 50 gallons contents.

The principle of the improvement feems to centre in this fimple point—The greater the quantity of heat that can be made to pafs through the body of the ftill in a given time, the greater will be the quantity of vapour, and confequently of fpirits, produced in that time: and certainly it is not eafy to conceive how this can be attained in any way fo effectually as by making the ftill *all bottom*, as it were, and applying the heat to every part of that bottom.

XV. *Obfervations on Spiders, and their fuppofed Poifon.* *By* M. Amoreux *jun. M.D.**

THIS genus of infects is as numerous in fpecies as the latter are varied. France contains almoft the half of the fpecies known. M. Geoffroy has mentioned only fixteen; but Dr. Lifter, who made obfervations of the fame kind in England, and M. Clerk, who carried them as far as any one in Sweden, have given a more complete hiftory of them. Scopoli, fo commendable in other refpects for his ufeful labours, does not appear to have done right in changing entirely the denomination of forty-four fpecies of fpiders, which he faw in

* From *Notice des Infectes de la France reputés venimeux.*

in Carniola, merely that he might have the pleasure of giving to each the name of some illustrious person who has promoted the science of entomology. This mark of honour is of little consequence to such great Mecenases, and the inconvenience of increasing and confusing the received nomenclature is very great.

The public care little also for the exact descriptions of naturalists, and their methodic classifications. They require facts; something wonderful and extraordinary. They wish that every natural being should present some new phenomenon; an object of immediate utility, or a subject of reprobation: and when their prejudices are once established, nothing can destroy them. Sometimes, for the truth must be confessed, naturalists in their writings have been the source of errors and prejudices. Were we to correct the assertions of Pliny, Johnston, Mouffet, and Aldrovandi, authors still quoted, and which one cannot read with patience, respecting insects only, we should make a large book of controversies, which would serve neither to instruct the learned, nor to undeceive the people, always wedded to their ignorance.

The history of spiders, and that of the effects of their venom, were it properly treated, would alone furnish matter for an ample chapter. What variety in the sensations of man! Some have an invincible aversion to spiders; and there are women who faint at the bare mention of their name*: others treat them with familiarity, and think it an act

* This antipathy is no less strong, though often more reasonable, among the men. M. Zimmerman relates the following singular instance of it, to which he was a witness:—"Being one day in an English company," says he, "consisting of persons of distinction, the conversation happened to fall upon antipathies. The greater part of the company denied the reality of them, and treated them as old women's tales; but I told them that antipathy was a real disease. Mr. William Matthew, son of the governor of Barbadoes, was of my opinion; and, as he added that he had himself an extreme antipathy to spiders, he was laughed at by the whole company. I shewed them, however, that this was a real impression in his mind, resulting from a mechanical effect. Mr. John Murray, afterwards Duke of Athol, took it into his head to make, in Mr. Matthew's presence, a spider of black wax, to try whether this antipathy would appear merely on a sight of the insect. He went out of the room, therefore, and returned with a bit

act of prowess to eat them. So many things have been related for and against the assertion of spiders being venomous, that we cannot but be cautious in regard to what has been said on the subject by different authors; we must therefore request those who relate such stories in future, to give a correct description of the kind of spider or other insect which they believe to be poisonous, together with their common and scientific names, which will remove all doubt and confusion.

Our spiders in France are in general rather ugly than formidable. If there are any suspected of being poisonous, it ought not to be the domestic spider with long claws, *aranea parientina* and *aranea phalangiodes* Linn. nor the mower of the fields, *phalangium opilio* Linn. the only kinds of the phalangia mentioned by Geoffroy; nor the mason spider, with which perhaps this author was unacquainted, because it inhabits the southern provinces; nor the orange-coloured spider, and that entirely white *aranea viatica*, and the *aranea citrina* Linn. found commonly among vegetables and fruit, and chiefly grapes; nor so many others which we see daily,

a bit of black wax in his hand, which he kept shut. Mr. Matthew, who in other respects was a sedate and amiable man, imagining that his friend really held a spider, immediately drew his sword in a great fury, retired with precipitation to the wall, leaned against it as if to run him through, and sent forth horrible cries. All the muscles of his face were swelled, his eye-balls rolled in their sockets, and his whole body was as stiff as a post. We immediately ran to him in great alarm, and took his sword from him, assuring him at the same time that Mr. Murray had nothing in his hand but a little wax, and that he might himself see it on the table, where it was placed.

He remained some time in this spasmodic state, and I was really afraid of the consequences. He however gradually recovered, and deplored the dreadful passion into which he had been thrown, and from which he still suffered. His pulse was exceedingly quick and full, and his whole body was covered with a cold sweat. After taking a sedative he was restored to his former tranquillity, and his fear was attended with no other bad consequences. We must not be surprised at this antipathy: the largest and most hideous spiders are found in Barbadoes, and Mr. Matthew was born in that island. Some one of the company having formed of the same wax, in his presence, a small spider, he looked at it while making with the utmost tranquillity, but it would have been impossible to induce him to touch it. He was not, however, of a timid disposition."

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and of which we have no cauſe to complain. If all our ſpiders were noxious, how many accidents would daily happen in houſes which are not kept clean, and to thoſe people who labour in the fields? In that caſe it would be highly proper to deſtroy them.

The brown, black, and hairy ſpiders, which reſide in vaults and cellars, as they inſpire the contagious air of dirty and uninhabited places, may have juices capable of doing hurt when they are bruiſed by accident on any naked part of the body, or introduced into the ſtomach. Of this, however, we have no well-atteſted proofs, though we know that the hairy ſpider is miſchievous, and that it attacks even waſps, the ſcales of which it breaks with its ſtrong forceps. But what ſhall we think of the popular opinion, that ſpiders loſe their venom in certain privileged places? This is related of the old tower of Pariſet at a league from Grenoble, ſituated on a mountain, and called by the populace *Tour Saint Verain*, to expreſs the tower without poiſon *; where, as is ſaid, no ſerpent, ſpider, or venomous animal is to be found: we are even aſſured, that thoſe carried thither immediately die.

Spiders have often attracted the attention of the curious by their manœuvres, their amours, and ſingular mode of copulation, as well as by their addreſs in ſpinning their webs, and forming cods, in which they incloſe their eggs; on account of their art in repairing the accidents which happen to their webs, and the breaches they make in them on purpoſe to deliver themſelves from too ſtrong a captive they have entangled; and of their perpetual wars, and the carnage they occaſion, &c. Theſe are the actions not of mere *au-*

* John Tardif, a phyſician, who wrote in 1618, ſpeaks very ſeriouſly of the tower without venom, as one of the wonders of Dauphiny. M. Lancelot, who reduced all the wonders of this province to their juſt value in a memoir upon this ſubject inſerted among thoſe of the Academy of Inſcriptions and Belles Lettres, Vol. VI. ſays, that the tower without venom is no longer worthy of that name. It is falſe that no venomous animals live near it; ſerpents and ſpiders are found there, as well as in other places. "I have ſeen ſome carried thither," ſays M. Lancelot, "for the ſake of experiment, and it did not appear that they found themſelves incommoded by the change."

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tomata, and which muſt aſtoniſh thoſe who view them with the eye of a philoſopher.

A worthy magiſtrate, M. Bon, who was fond of natural hiſtory, at a time when it was neceſſary to ſurmount many prejudices, found means to breed ſpiders, and to extract ſilk from their cods, which he opened. All ſpiders are not weavers, but they are ſpinners, and all live by hunting. This hunting, for the moſt part, is only ſtationary, like that by decoy. Theſe hunters diſplay conſiderable cunning and addreſs to make their prey fall into the ſnares which they have laid. One kind, the *aranea domeſtica*, extends its net horizontally in a corner, hooks itſelf to it, and in that manner lies in wait for its prey; another, the *aranea dumetorum*, places its net in a vertical poſition acroſs an alley in a garden, to intercept the paſſing inſects; one conceals itſelf in its cavern, and darts forth on the ſmalleſt noiſe; and another ſuſpends itſelf from the branch of a tree by a long thread, and acts the tumbler, to attract ſtupid ſpectators. There are ſome which cover their cave on the outſide with a kind of white ſilk, as if to announce, by a beautiful entrance, that there will be no danger to proceed farther: this is merely a decoy. Such is their occupation, their reſources, and their induſtry. As in every numerous race there are vagabonds, ſome ſpiders employ themſelves only in running about, and in jumping. Such are the habits of the wolf ſpider. There are ſome alſo exceedingly cruel, which employ their arms with great force and activity.

The ſtructure of ſpiders is no leſs remarkable than their habits. They have always eight eyes, but differently diſpoſed; and this has enabled naturaliſts to divide them into different claſſes, in order that they may be better diſtinguiſhed. M. Fabricius, however, has made known five ſpecies with only ſix eyes. This is denied by M. Geoffroy, who apparently had not ſeen theſe ſpecies. But the moſt intereſting organ in theſe inſects is their mouth, ſince it is with this alone that they are able to hurt us. The mouth of the ſpider conſiſts of two ſtrong forceps, terminated by a kind of very ſharp claws, the points of which are bent down-

downwards *. These forceps or claws are moveable, and can easily be turned upwards or downwards, and even from right to left. It is with these instruments that the spider seizes, pinches, and kills its prey. The points also serve it as a mouth: though their extremity is very sharp, it is pierced towards the end; and the inside of the forceps is hollow; so that the spider by these means sucks up the moisture of flies, or of other insects which it seizes.

Swammerdam says, that what might be taken for teeth in the spider are real stings or darts with which it pierces those animals the blood of which it sucks: but this observer did not believe that the spider emitted from these darts a venomous liquor. Lister, who says he had certain proofs of spiders being venomous, expressed the poison from these instruments. Leuwenhoek also advances, that the venom of the spiders is contained in the cavity of the sharp pincers which proceed from the mouth of the insect. Others have said that these forceps are not hollow, but that the venom proceeds from a small trunk which issues from the mouth at the moment when the insect seizes its prey. It is possible, and even probable, that different kinds of spiders have a different organisation; and it is a certain fact, that many spiders, and perhaps all of them, throw out from their mouth a certain liquor, with which they moisten their prey. We may rest assured, however, that our spiders have nothing in them of a venomous nature; and this is proved by our so often touching them without danger. They are often between our teeth when we eat fruit and certain kinds of vegetables, yet we perceive no other bad consequences from them than those which may arise from fear and the idea of dirtiness. There are even spider-eaters, who make a sport of swallowing them: some do it through whim, others through a depraved taste, and some to shew their courage, or to gain a wager †. Redi

* This description is according to Geoffroy, Vol. III. p. 631. Those of Linneus and Fabricius are as follows: *Aranea. Os unguibus s. retinaculis duobis. Palpi duo articulati*, Linn. *Aranea. Labium breve, apice rotundatum. Palpi duo incurvi, maris clavati.* Fabric.

† Instances of spider-eaters may be found in the Ephemerides of the Searches into Nature, the Philosophical Transactions, and in Vanderwiel, who has collected a great many from different authors.

saw

ſaw people who ate ſpiders, and, from the experiments which he made, he does not believe them to be poiſonous. Dr. Fairfax is of the ſame opinion. Clerk and Roëſel maintain, that ſpiders are not ſo venomous as is ſuppoſed, ſince many perſons ſwallow them. It is related by the *Peintre Naturaliſte*, that a man pretty far advanced in life ate all the ſpiders which he found, and that they ſerved him as a purgative. He ſpread them on a ſlice of bread, as if they had been excellent marmalade. The ſame naturaliſt confutes the popular error, that the ſpider is able, by its pricking, to kill the toad. He ſaw nothing of the kind, though he made various experiments on that ſubject.

[To be concluded in the next Number.]

XVI. *Some Account of the late* MARK ELEAZAR BLOCH, *of Berlin.*

MARK ELEAZAR BLOCH, a Jewiſh phyſician eſtabliſhed at Berlin, and well known by his Natural Hiſtory of Fiſhes, was born at Anſpach, in Franconia, of very poor parents. His father, who was exceedingly devout, ſpent his whole time in reading the Bible and the Talmud; while his mother, by ſelling old clothes, and other things of the like kind, gained enough to maintain her huſband and children. M. Bloch, at the age of nineteen, could not read German, and did not know a ſingle word of Latin. He had read only a few Rabbinical books, and ſpoke a kind of Franconian gibberiſh mixed with the Judaic jargon. A Jewiſh ſurgeon, ſettled at Hamburgh, having taken him into his houſe to inſtruct his children, he learned good German by hearing the gazettes read, and afterwards by ſtudying the language. He lived ſo economically that he ſaved from his ſcanty ſalary as much as enabled him to pay for inſtruction in the Latin, which he was taught by a ſtudent as poor as himſelf. He acquired, at the ſame time, ſome knowledge of ſurgery; and, as he had relations at Berlin, he repaired to that city to ſtudy anatomy. Having ſurmounted various difficulties, and got himſelf admitted as Doctor in the Univerſity of Francfort,

 he

he returned to Berlin and made himſelf known to M. Martini, by whoſe means he was elected a member of the Society of the Friends of Nature.

M. Bloch, in order that he might promote the objects of that inſtitution, undertook a natural hiſtory of the Muræna, a fiſh caught only in the lakes of Pomerania. He began to form a cabinet of natural hiſtory; and having made a conſiderable collection of aquatic animals from all parts of the globe, he reſolved to write a natural hiſtory of fiſhes. He cauſed drawings to be made and engravings to be executed from them with great correctneſs. By a fortunate accident he procured the original manuſcripts of Father Plumier, at the ſale of one of thoſe Frenchmen who came to Brandenbourg at the time when Frederic II. eſtabliſhed the adminiſtration of exciſe. Father Plumier, of the order of the Minims, had made three voyages to America, and always brought back many intereſting objects. Though he publiſhed nothing but on botany, if we except the art of turning, it is well known that he wrote a great deal on birds and fiſhes; but no one could tell what had become of theſe manuſcripts: and it is ſtill unknown in what manner they came into the hands of the above Frenchman, from whom they paſſed into thoſe of M. Bloch.

This naturaliſt firſt publiſhed, in German, four numbers of an Economical Natural Hiſtory of Fiſhes, particularly thoſe in the States of Pruſſia, with figures from original drawings: Berlin, 1781 and 1782; large quarto. In the following years he gave an Economical Natural Hiſtory of the Fiſhes of Germany, in three volumes, conſiſting of 108 plates, and in which the three numbers above mentioned were inſerted. He publiſhed afterwards, in nine volumes, the Natural Hiſtory of Foreign Fiſhes; ſo that his whole work, conſiſting of twelve volumes, contains 432 plates. The laſt appeared in 1795. He cauſed alſo to be made, at his own expence, by C. Laveaux, then at Berlin, a French tranſlation of his work, which he publiſhed under the title of *Hiſtoire generale et particuliere des Poiſſons*, Berlin 1785—1788; ſix volumes folio, with 216 plates. It may be readily conceived that the expence of ſuch a work muſt have been

confiderable; unfortunately the number of the fubfcribers and purchafers was not fufficient to defray it. M. Bloch had the misfortune alfo to lofe his only fon, already diftinguifhed by his talents, who died at Paris in 1787, when on a tour to France and England to procure fubfcribers to the French edition of his father's Hiftory of Fifhes. This lofs plunged M. Bloch, already oppreffed with labour and expence, into the deepeft affliction. He however ftill continued to employ himfelf on his Hiftory of Fifhes, and, having concluded it, undertook a journey to Paris. This diligent naturalift, who has rendered great fervice to ichthyology, died at Carlfbad, in Bohemia, on the 6th of Auguft 1799. Befides the above voluminous works, M. Bloch publifhed a great many memoirs on Natural Hiftory in the Tranfactions of different Societies. His Differtation on the Muræna, publifhed in the Memoirs of the Friends of Nature at Berlin, has been mentioned already. In the fame work he publifhed alfo the following:—Obfervations on the regular Depreffions in Vitriform Stones; on the Worms in the Inteftines and Lungs of Birds; an Effay towards the Natural Hiftory of the Worms which live in other Animals; on Worms of the Bladder; Defcription of the Buftard and fome kinds of Birds found in Marfhes; on the Oil of Herrings; on the vulgar Opinion that the Organ of Generation in the Ray and Shark is double; on the *Myxina glutinofa* Linn. &c.

XVII. *A Communication from Dr.* LOANE, *relative to Pneumatic Medicine.*

A CASE OF ATONIC GOUT CURED BY VITAL AIR.

AUGUSTUS ERNEST, Efq. in the beginning of Auguft 1799, was feized with fymptoms of afthma, great wheezing, and difficulty of breathing, cough, mucous expectoration, and incapacity of lying in an horizontal pofture. Hence arofe much œdema of the lower extremities. Different medicines were tried without effect, when Lord Egremont urged him to make trial of the oxygen air, under Dr. Thornton, September 22. This remedy was had recourfe to; and

and after inhaling the vital air but a few days, ſo much benefit was derived, that the patient was enabled to lie compoſed in bed during the whole of the night; and after a fortnight, ſo great was the energy produced, that the gout made its appearance in the great toe of the left leg. The aſthma from this period quitted Mr. Erneſt, and the inflammation continued for the ſpace of ten days in the toe and parts adjacent; and the ſubſequent ſwelling gradually ſubſiding, the patient was reſtored to perfect health. He then went to Lord Egremont's, previous to which I received the following ſatisfactory letter:—

Letter to Dr. Loane.

November 9, 1799.

DEAR SIR, Warwick-ſtreet, Golden-ſquare, No. 7.

I am juſt going into Suſſex to breathe there ſome of the pure atmoſpherical air; but I cannot leave this metropolis without reiterating to you and Dr. Thornton, with the tendereſt feelings of gratitude, the warmeſt acknowledgments for the great benefit you have conferred on me by adminiſtering to me the vital air: indeed, when I compare the ſituation in which I was at the end of September, when I, as a dying man, came under both your care, to what, thank God, you have brought me now, it ſeems to me quite miraculous, and I ſhall always look with aſtoniſhment at the wonderful diſcovery which has been made ſo lately of the oxygen air.

I am, with ſincere regard,
Ever faithfully yours,
AUGUSTUS ERNEST.

Obſervation.—When he returned to London, his friends, Lord Romney, Count Bruhl, &c. congratulated him on his recovery; but his aſthma ſoon after made him a ſecond viſit, and the vital air was again reſumed, when in a few days it brought on another attack of the gout in both feet, which went off kindly, leaving the patient in excellent health and extraordinary ſpirits.

It may be proper to mention, the average doſe of vital air daily given was ſix quarts, mixed with twelve of atmoſpheric air, and this was conjoined with the medicines moſt commonly exhibited upon ſuch caſes.

INTELLIGENCE,

AND

MISCELLANEOUS ARTICLES.

ROYAL SOCIETY OF LONDON.

AT the meeting, February 6, Dr. Young's paper on Sound was concluded. A paper by Mr. Cooper on the effects occasioned by the destruction of the membrana tympani, was begun.

On the 13th Mr. Cooper's paper was concluded. By this ingenious paper it appears the sense of hearing is very little impaired by the loss of the membrana tympani.

A very curious and interesting paper on the spontaneous emission of light by various bodies, by Dr. Hulm, was read on the 13th and 20th: it contains a number of experiments, some of which prove that light is a component part of all marine fishes; others, that putrid fish cease to be luminous, rotten wood to shine, and glow-worms to emit light, when surrounded by a frigorific mixture.

FRENCH NATIONAL INSTITUTE.

In the sitting of the French National Institute, Vendemiaire 15, year 8, October 7, 1799, C. Cuvier read the following account of the labours of the Mathematical and Physical Class during the last quarter of the year 7:—

The diamond, so valuable on account of its rarity and splendour, and so flattering to the vanity of man, had long ago attracted the attention of philosophers by other qualities. The ancients considered it as the most unalterable of bodies, and made it the emblem of the immutability of the decrees of Fate:—

> ———————— Si figit adamantinos
> Summis verticibus dira necessitas
> Clavos.

Mankind were much surprised when experiments proved what the genius of Newton had divined—that the hardest and

and moſt untractable of ſtones is converted into a little ſmoke and ſoot. But the queſtion was, What is the nature of this combuſtible body? Is it a particular ſpecies, like ſulphur, or phoſphorus? or is it a compound of different combuſtible bodies, as oils and bitumens? There was only one way of anſwering theſe queſtions—to collect the product of its combuſtion. This has been done, and the product was found to be abſolutely the ſame as that of the combuſtion of charcoal; that is to ſay, that deleterious vapour to which chemiſts have given the name of carbonic acid gas. Are the diamond and charcoal then the ſame thing? or, if not, in what do they differ? This is the problem which C. Guyton propoſed, and which he has reſolved. He firſt ſaw the diamond change itſelf into carbonic acid without leaving a reſiduum: if it differs then from charcoal, it is only becauſe it contains ſomething more. It produces much more of that acid, becauſe it abſorbs more oxygen during combuſtion than charcoal does; and if the combuſtion be ſuſpended at a certain point, which C. Guyton did, by burning the diamond by means of the ſolar rays, you obtain real carbon. Thus common charcoal, making allowance for the earthy and ſaline matters which form the aſhes, is not a ſimple ſubſtance, as hitherto believed. The diamond, by its firſt combination with oxygen, is converted into that ſubſtance of which the Engliſh make pencils, and which is called plumbago; by a ſecond degree, into common black charcoal; and by complete ſaturation, into carbonic acid. The diamond, then, is really that ideal and ſimple being which chemiſts called carbon, and common charcoal is only carbon more oxygenated; that is to ſay, the two ſubſtances, which in their uſual ſtate appear to us the moſt tranſparent, form, by their union, the blackeſt and moſt opaque of ſubſtances, and one of the commoneſt of ſubſtances contains a great part of its weight of that which we conſider as the moſt valuable.

But C. Guyton has done more. It is well known that iron is converted into ſteel by combining itſelf with a certain quantity of carbon. C. Guyton was deſirous of aſcertaining in what ſtate carbon entered into this combination, and, above all, whether it abandons its oxygen to form ſteel: C. Guyton

C. Guyton has declared in the affirmative. Agreeably to the views which directed Clouet in his discovery of making cast steel, C. Guyton changed soft iron into that steel with the diamond alone in a close vessel; and common charcoal did not produce steel but when treated with some agent capable of depriving it of its oxygen. Many poets have compared the hardness of the armour of their heroes to that of the diamond, without knowing that their comparison was founded on so real an intimacy. (See Phil. Mag. Vol. V.)

The same chemist has directed his attention to two metallic substances little known, though sufficiently abundant. One of them, named *nickel*, is not yet generally considered as a particular metal: some chemists think that it is only an alloy of several metals. C. Guyton is of a different opinion: he thinks that it may be possible to take from nickel all the iron with which it is mixed, and that it will even then retain properties hitherto found only in iron—that of attracting the magnetic needle, and that of becoming magnetic itself.

The second metallic substance he examined is *tungsten*; a word which signifies heavy stone, because some of its ores have a stony appearance. It is not long since it was known to be a metal, and hitherto it had been reduced and melted only in an imperfect manner. C. Guyton, having succeeded better than his predecessors, has found that the specific gravity of this metal is much less than what had been supposed; it does not much surpass that of copper. He is of opinion that tungsten can be of little use but by the property which its oxyds have of fixing vegetable colours.

The public has been informed a year ago of the success of the researches of C. Fourcroy and Vauquelin on the stone of the bladder. This concretion, which occasions the most excruciating pain, and which the Faculty despaired of being ever able to dissolve, may be dissolved in certain cases by agents sufficiently mild not to injure the bladder. These two chemists have also united their efforts this year, and turned their attention to the liquid in which the stone is formed. Notwithstanding the numerous labours of which urine has been the object, they found in it new and very remarkable

markable things: they discovered in it a particular substance, to which urine is indebted for its colour, its taste, its odour, and, in a word, all its characteristic qualities. This substance, to which they have given the name of *urée*, has singular properties: by the action of fire it is changed entirely into carbonat of ammonia; it crystallises either alone or in union with the nitric acid; it is exceedingly soluble; but the strangest phenomenon is, that marine salt, which generally crystallises in cubes, is changed into octaedra; and that salammoniac, which crystallises in octaedra, is changed into cubes when mixed with this substance. C. Fourcroy and Vauquelin having remarked, in their analysis of *urée*, that it contains an extraordinary quantity of azote; that is to say, of that non-respirable part of our atmosphere which enters as an essential part into all animal substances; and, if I may be allowed the expression, that it was a matter too much animalised; have concluded that urine is chiefly destined to carry off the superfluous portion of this azotic principle which is found in the human body. Thus each of the elements of which the body is composed, is conveyed from it in a particular manner; the lungs free it from carbon in respiration, the liver from hydrogen in the production of bile, and the reins from azote in that of urine.

C. Chaptal has described the art of the scowerer, which, though despised because not lucrative, is, however, founded on knowledge and a multitude of facts which can be learned only from the higher branches of chemistry. (See Phil. Mag. Vol. V. p. 43.)

C. Chaussier has been so fortunate as to discover a new chemical production, and, at the same time, a useful remedy in various diseases:—it is a combination of sulphur with alkalies, in which the former is more abundant than in the usual hydro-sulfures, commonly called liver of sulphur, without being, however, in the state of an acid. The union is more intimate than in the hydro-sulfures; and this combination, which C. Chaussier calls sulphurated hydro-sulfure, has not the smell of liver of sulphur. The sulphurated hydro-sulfure of soda is formed on a large scale, when Glauber's salt, or sulphat of soda, is decomposed by carbon. This substance has been employed with success in some chronic diseases,

 and,

and, when diffolved in water, it may form a very good fubftitute for certain kinds of fulphureous mineral water.

C. Latreille has explained the habits and induftry of a fmall bee, which does not live in fociety like our domeftic bee. It does not build edifices like the common bee, remarkable for their matter and the geometrical manner in which they are conftructed; but it knows, at any rate, how to render its fmall habitation agreeable. Bits of the petals of the corn-poppy, cut round and rolled up with art, forms a fplendid tent with real purple curtains, in which it depofits an egg, with a portion of nourifhment fufficient for the young one about to be hatched. Another infect defcribed by C. Latreille is remarkable for the havoc it occafions, as it feeds only on the young of the domeftic bees. It even fearches for them when it is not deftitute of other prey, and deftroys a great many of thefe infects. It is of a genus which approaches near to that of the wafp.

C. Huzzard read to the Clafs the obfervations of the late Flandrin on animals bit by a mad dog. It appears from thefe obfervations that graminivorous animals, fuch as horfes, cows, &c. may become mad when bit, but that they cannot communicate this horrid malady to others.

C. Champagne gave the following account of the labours of the Clafs of the Moral and Political Sciences during the laft quarter of the year 7:—

C. Bouchaud read two memoirs on the colonies and municipia of the Romans. C. Bougainville read an account of the embaffy of the five nations during the war of Canada in 1757. C. Mentelle read a memoir on the extent and population of the kingdom of Poland, and the increafe of power which Ruffia, Pruffia, and Auftria have acquired by the partition of that country. It refults from his refearches, that Poland, before the firft difmemberment, occupied an extent of 13510 fquare Polifh leagues of 20 to a degree: that the population was 7,660,787 individuals, and 795 individuals to a fquare league: that the total amount of the taxes both direct and indirect was 37,173,237 florins, about 25,652,293 francs. The part which fell to Ruffia by the two partitions amounted to 6069 fquare Polifh leagues, containing a population of 2,195,161 individuals,

individuals, with a revenue of 8,000,000 francs. Auftria obtained an extent of 3876 fquare Polifh leagues, with a population of 3,778,010 individuals, and a revenue of about ten millions of francs. The part of Pruffia amounted to 4288 fquare Polifh leagues, with a population of 3,764,509 individuals, and a revenue of fix or feven millions of francs.

C. Lefcalier read a memoir on the ifland of Madagafcar. This memoir forms part of a voyage to India, which the author travelled through, and contains details refpecting the population of Madagafcar, its productions, and the induftry and manners of its inhabitants. C. Lefcalier has difcovered, that the manners, cuftoms, and, above all, language of the inhabitants of Madagafcar, have a ftriking refemblance, notwithftanding the diftance, to thofe of the inhabitants of Otaheite and the other iflands of the South Sea.

C. Fleurieu read a memoir on the application of the decimal metric fyftem to hydrography and the calculations of navigation.

C. Buache read a memoir on the lands difcovered by La Peyroufe on the coaft of Tartary and to the north of Japan. La Peyroufe explored the channel of Tartary, and his labour appears to be correct. He examined fome parts of the land of Yeffo, and confirms the truth of the difcovery made of it by the Dutch in 1643, and the exactnefs of the defcription they have given of it. But the Dutch and Peyroufe only faw fome points of that land, the great part of which ftill remains to be explored. The Ruffians had before made fome voyages to Yeffo; and it appears that it is not a large country, as the Dutch and Peyroufe imagined, but a group of feveral iflands.

C. Lacepede, of the Clafs of the Phyfical and Mathematical Sciences, read a memoir on a new zoological chart. Naturalifts, in treating of the different kinds of mammiferæ, birds, reptiles, and fifhes, have pointed out, with care, the countries which they inhabit. But, to complete the hiftory of animals, it was neceffary that the naturalift fhould determine the influence which the different climates have in changing or improving their faculties and form, and in regard to the prefervation or degeneration of the fpecies. To obtain a folution to this important problem, the author traces out a zoo-

logical chart, not according to the political or accidental divisions of the earth, but merely according to those physical boundaries which have been admitted by geographers. He takes his departure from the meridian of France, and divides the globe into twenty-six divisions, of sufficient extent to obtain sensible differences. By means of these comparable degrees, the naturalist will be able to ascertain the differences between animals, and even the variations in the same forms and species. This grand view of Lacepede, by leading to more exact descriptions and more accurate observations, will serve to give more extent to the science of the naturalist.

PHILOMATIC SOCIETY, PARIS.

C. Noel, in a memoir read in the Society, after taking a view of the advantages which might result from naturalising salt-water fish in rivers and ponds, and particularly the herring, pointed out the means to be employed for that purpose. These means are, to construct an artificial pond between two islands of the Seine, and to deposit in it herrings full of roes both hard and soft, which might be carried thither by one or more boats. To ensure the success of this first operation, the same boats might repair to the fishing banks, when the herrings have spawned, and take up a lading of fecundated ova to be carried to the artificial pond, with certain precautions which the author points out in his memoir. C. Noel mentions a great many instances which seem to prove that the herring is fond of fresh water; and, among other facts, he relates an experiment of Dr. Franklin, who stocked one of the rivers of New England with herrings by depositing in the water leaves of plants covered with ova. To add some force to the proofs adduced, C. Noel takes a view of the different kinds of fish which, by the art of man, have been transplanted from one climate to another.

C. Chantran read a memoir on the smut in wheat, and its acid. After remarking, that stalks which bear charred ears differ in nothing from others, and that these ears often contain good and bad grains, he thought himself authorised to advance, that this disease does not exist, as generally believed, in the germ of the seed from which they sprung. However, he does not consider liming the seed as useless; he thinks it

 destroys

deſtroys the animalculæ attached to the ſeeds, and that the reaſon of its not entirely extirpating the ſmut is, becauſe it cannot act on thoſe ſmall inſects which occaſion it, and which happen to be ſcattered in the ground.

Having analyſed forty-ſix grains of ſmut, he found in this ſubſtance an acid eaſy to be demonſtrated by ſuch an analyſis as could not poſſibly produce it in the courſe of the proceſs. Thus, boiling water infuſed over it, gave a ſtrong tinge of red to tincture of turnſole, while the remainder of this tincture retained its former character. Smut, deprived of its acid, and calcined in the open air, emitted the odour of burnt corn, and gave a reſiduum ſix times as large as the ſame quantity of the farina of wheat treated in the ſame manner. This joined to microſcopic obſervations, ſays C. Chantran, proves the animal nature of this ſubſtance, and a difference between it and the farina of wheat, greater than could ariſe merely from diſeaſe.

The acid of ſmut is not volatile, and may be concentrated by diſtillation. With lime and with ammonia it forms an inſoluble ſalt. This laſt character diſtinguiſhes it from the phoſphoric acid. Combined with pot-aſh, it gave a ſalt cryſtalliſed in ſmall deliqueſcent needles of a bitter taſte. It decompoſes carbonat of lime.

LYCEUM OF THE ARTS, PARIS.

In the ſitting of the 24th of Pluvioſe, Feb. 13, C. Bruley read a note reſpecting the Nopal, called commonly in the Antilles *Bois des Indes,* and which nouriſhes the inſect that produces cochineal. He announced at the ſame time a very ſingular phenomenon, which is, that in the *Jardin des Plantes* at Paris there are ſeveral nopal plants, brought to France by C. Delahaye, covered at preſent with inſects exceedingly voracious; from which it is expected that cochineal may be cultivated in the neighbourhood of Paris ſufficient for the conſumption of the French manufactures. C. Bruley promiſed to preſent, at the next ſitting, nopal plants covered with the living inſects, and a piece of ſcarlet cloth dyed with Pariſian cochineal, which, he ſaid, was equally beautiful as that dyed with American cochineal.

CHILD FOUND IN A SAVAGE STATE.

Many of our readers muſt recollect the particulars reſpecting Peter the wild boy, found in the woods in Hanover, who was afterwards maintained in this country at the expence of Government, and who died ſome years ago: they will alſo be able to recollect the wild girl found in the woods of Champagne in France: both of which inſtances were employed, among others, by Lord Monboddo to ſupport his whimſical idea that mankind originally went on all-fours. Another inſtance of a wild individual of the human ſpecies has recently occurred, as appears by the following extract of a letter from the adminiſtrator of the hoſpital of Saint Afrique, which we copy from a late French journal:—

"The attention of the inhabitants of this commune has been attracted this morning by a very ſingular phenomenon. A child, caught in the woods of Lacaune by three huntſmen, was brought to our hoſpital, of which I am one of the adminiſtrators. On their approach, this child, which was quite naked, betook itſelf to flight, and climbed up a tree. When brought to Lacaune, it made its eſcape; but it was again caught in the woods in the neighbourhood of Saint Sernin, and carried to the houſe of C. Conſtans, Saint Eſteve, commiſſioner of government. The ſoldiers who attended it thither aſſured me, that it was caught in the manner above related. It is certain that it feeds only on potatoes and nuts. If you give it bread, it ſmells it, bites it, and then ſpits it out: the caſe is the ſame with other kinds of aliment. From theſe facts there can be no doubt that it has lived a long time in the woods. But how was it able to withſtand, while quite naked, the ſeverity of the preſent winter in the woods of Lacaune? This is the higheſt and coldeſt mountain in this part of the country, and the cold was greater this year than in 1795. This child ſeems to be only ten or twelve years of age at moſt. It is well ſhaped, and its eyes are black and lively. It is always endeavouring to eſcape. This morning, having ſuffered it to go out into the fields contiguous to the hoſpital, it began to run as faſt as it could, and, if it had not been cloſely followed and caught, it would have ſoon gained

gained the mountain and diſappeared. We have made for it a ſmall dreſs of grey cloth, by which it ſeems to be much embarraſſed, and which it does not know how to get rid of. We ſuffered it to go out into the garden, but it endeavoured to eſcape, and attempted to break one of the bars of the gate, which is of lattice-work. It does not ſpeak. When offered potatoes, it takes as many as its pretty little hands can contain. If they are boiled (for it prefers them ſo) it peels them, and eats them like an ape. It laughs in a very agreeable manner, and, when robbed of its potatoes, ſends forth a ſhrill cry. Conſtans imagined that it was deaf, but we have convinced ourſelves of the contrary; at moſt, it is only dull of hearing."

BOTANY.

C. Brouſſonet, the French vice-conſul at Mogador on the coaſt of Barbary, having been obliged to abandon his ſituation on account of the bad treatment he experienced and the ravages occaſioned by the plague, and to retire to the Canaries, has employed his leiſure time in examining the ſoil and productions of theſe iſlands, of which he propoſes to publiſh a natural hiſtory. In one of the iſles he found the glacial *meſembrianthemum criſtallinum* Linn. cultivated on a large ſcale by the inhabitants, to whom it furniſhes abundance of ſoda. Brouſſonet obſerved in the iſland of Teneriffe eight kinds of laurel, ſeveral of which appear to be new.

METEOROLOGY.

"On the 11th inſtant there was a very curious phenomenon here; an inceſſant ſhooting of the ſtars from 11 o'clock at night till day-light the next morning, deſcribed by ſome as a ſhower of fire; it was, indeed, magnificently awful."

"Barbadoes, Nov. 24, 1799"

On the 6th of December a curious phenomenon was obſerved at Aoſta. At ten in the morning, two parhelia, or mock ſuns, were ſeen, of the ſame ſize as the real ſun, but ſomewhat paler. One of them had a long white tail, in ſhape reſembling a ſword. An hour afterwards, the three ſuns formed a ſemicircle, the real one being in the middle. This ſemicircle ſoon changed into ſeveral others, and at length ſix

of

of them were seen one above the other. These also vanished again, but the two parhelia remained. At four in the afternoon, previously to the setting of the sun, the mock-sun in the west disappeared, and afterwards that in the east.

Von Humboldt's Expedition to Spanish America.

The two following letters from this indefatigable philosopher to one of his friends in Germany, have been published in one of the foreign journals:—

Corunna, June 3, 1799.

I wrote you from Marseilles, that I had been disappointed in my hopes of undertaking a voyage round the world with Captain Baudin (to which I had been invited by the French Government) just at the moment when I was going down to the port to embark. After this I proposed to go out to Bonaparte with the second expedition from Toulon, and my friends were anxiously expecting me; but this expedition was rendered impossible by the battle of Aboukir. Firm to my purpose, I then wished to go by a Swedish frigate, expected at Marseilles, to Algiers, in order that I might undertake, with the caravan of Mecca, that dangerous journey through the desart of Selima to Cairo. The frigate, however, did not arrive; and, after waiting two months to no purpose in Provence, as war had broken out between France and Algiers, I proceeded to Spain. I had procured recommendations to the king, and received from him what no foreigner ever obtained—letters of recommendation to all the viceroys, and permission to traverse all the Spanish settlements with my instruments.

You must acknowledge that I have been exceedingly fortunate. I have been provided with every thing necessary, and in a few hours shall sail, in the Spanish frigate Pizarro, for the Havannah; from which I intend to proceed to Peru, Mexico, and Chili. I shall be absent for several years, but I flatter myself with the hopes of accomplishing something of importance.

Bonpland, a young French botanist, accompanies me. I shall write you from the Havannah.

Alex. Von Humboldt.

Orotava

Orotava in the Island of Teneriffe,
June 24, 1799.

We left Corunna on the 5th, and arrived, without any accident, at Lancerotta on the 16th, and St. Croix, in Teneriffe, on the 17th. We were in sight of four English frigates, which we escaped, but we cannot tell how.

I have examined the peak with great attention; I was almost in the crater at the height of 11,500 feet. This excursion was attended with more fatigue than danger.

We found the heat of the crater on the ground 70° Reaum. and the air at 2°. The pumice-stone, which has occasioned so much dispute, is obsidian-stone fused and decomposed. It is here as clear as the day. I am so tired that I must conclude my letter. We are just going to set out for Caraccas and the Havannah.

ALEX. VON HUMBOLDT.

NOURISHMENT BY ABSORPTION.

Dr. Van Mons, of Bruffels, has lately announced the following circumstance:—Having a patient under his care, who, on account of a wound in the throat, was incapable of swallowing any kind of nourishment for several days, he kept him alive during that period by applying to the skin, in different parts of the body, several times a-day, a sponge dipped in wine or strong soup. He concludes from this fact, that the absorbing vessels of the skin are capable of conveying the fluids communicated to them to the interior parts of the body, as the latter convey the assimilated nourishment to the blood. It should be remarked, however, that from Dr. Rollo's experiments on diabetic patients, it did not appear that water was absorbed by the skin: but this may have been owing to something peculiar in the absorbent system of such patients; for one of our own navigators (Captain Inglefield or Bligh, we do not recollect which,) kept their companions from perishing of thirst, by applying sea-water to the skin.

GASEOUS OXYD OF AZOTE.

We have seen this gas inhaled: it seems to produce, through the medium of the lungs, the same effect that alcohol does through the medium of the stomach—intoxication.

tion. Does not this intimate, what would be little expected, that it probably contains a large portion of hydrogen?

DEATH.

At Paris, on the 23d of October last year, at the age of 77, Louis James Goussier, member of several learned societies. He was born in 1722, and applied at a very early period to the study of the mathematics. His first labours were, to arrange and superintend the publication of the memoirs, which the celebrated Condamine gave to the public in 1751, on the measurement of the three first degrees of the meridian in the southern hemisphere. In consequence of the ability which he displayed by the part he took in this interesting work, he was invited to co-operate in the Encyclopedie with Diderot and D'Alembert. Being charged with the part respecting the mechanical arts, Goussier exercised several of them himself, that he might be better able to give a description of them; such as those of watch-making, lock-making, cabinet-making, turning, &c. His articles display clearness, precision, and method. About the year 1760, the Baron de Marivet invited Goussier to reside with him, in order that he might improve himself in natural philosophy. In 1779 they distributed the prospectus of a New Philosophy of the World, which they proposed to publish conjointly, and which was to make fourteen volumes in quarto; but it was never carried farther than the eighth. Goussier was fond of travelling on foot, and in this manner went over all France. He had a great attachment to hydraulics, and was acquainted with every river and canal in the kingdom. With the same Baron Marivet he published, in 1789, a work, in two volumes octavo, on the Internal Navigation of France, with an Atlas adapted to the subject. He invented several curious pieces of mechanism, among which is a mill with portable arms for sawing planks. This piece of mechanism was sent to Poland to serve as a model for the mills destined to manufacture the timber of the immense forests of that country. He invented also a water level, much used by land surveyors.

THE

PHILOSOPHICAL MAGAZINE.

MARCH 1800.

I. *Obſervations reſpecting Oyſters, and the Places where found.* *By Profeſſor* BECKMANN.

OUR knowledge reſpecting the nature and organiſation, mode of life, nouriſhment and propagation of theſe ſhell-fiſh, is confined, defective, and uncertain. They live in a medium which ſcreens them from our obſervation; they are found on coaſts which few naturaliſts frequent, and are ſo different from all other animals, that, even from the obſervations which have been made on them, very little can be concluded. I ſhall leave it to naturaliſts to collect, arrange, and explain theſe obſervations, as the following, in my opinion, will be ſufficient for the object I have in view by the preſent paper *.

Oyſters live on the ſhores of the ſea, and particularly ſuch as are ſandy or ſtony; on the coaſts of iſlands, on rocks which project into the ſea, and on ſand-banks; but they ſeem to thrive beſt at the mouth of ſtreams, where the water of the latter renders the water of the ſea milder. The animal ſlime which the ſtreams carry along with them, and which is accumulated on the ſhores, may ſerve them as food.

Oyſters ſpawn chiefly in ſpring, when the ſun again begins to warm the water of the ſea; and what they then throw out conſiſts in ſmall oyſters completely formed, which ſeem to be

* Oſtrea edulis LINN.

be innumerable. Each of thefe young ones expands to a complete oyfter, in the fame manner as the feeds or fruits of thofe plants which have hermaphrodite bloom. I muft here obferve, that thofe are miftaken who fpeak of male and female oyfters; for how could procreation be poffible among animals which either do not change their place during their whole lives, or can change it only perhaps for an inch, and which are capable of no other movement than that of opening a little their fhells?

Thefe fhells are very often covered with productions of the coral kind: they are frequently loaded alfo with fmall mufcles and multitudes of worms, but only on the convex fide, which appears to be the upper one, fo that the animal refts on the flat fide. It frequently happens that both fhells are quite pierced through, and gnawed by worms, in the fame manner as old wood. All thefe enemies endeavour to deftroy thefe harmlefs animals, and the cafe is the fame with the worms which are found between the flefhy parts of their body, and in many places more abundant than in others *. A more formidable enemy for oyfters, however, is that eel-formed fifh which at Heiligeland is called *nugnogen*, but which by fome has been called the five-fingered fifh †. It is found fometimes in oyfter-fhells that are quite clofe, and in which no traces can be difcovered of the firft inhabitant. It lies in the fhell bent like a ring, and the fifhers unanimoufly affert that it eats the oyfter. On that account the

* Befides thefe worms, there are found, on fhells which have not been long taken from the fea, another kind, exceedingly fmall, which emit a phofphoric light, that may be obferved when they are thrown againft a hard body in the dark, or fuffered to fall on a ftone. They are mentioned by Lemery in his Dictionary of Drugs. It appears to me that they are perfectly fimilar to thofe which I have feen drawn up from the fea on ropes. Linnæus gives to this fpecies the name of *Nereis noctiluca*.

† *Ophidion imberbe*, a name borrowed by Linnæus from Rondelet. Befides the writers quoted by Linnæus, I fhall refer the reader to *Gefneri Hift. aquatil.* p. 105, under the *Afelli*. In Klein, p. 55, it is called *Euchelyopus flavus imberbis*. Schelhammer's *Anat. Xiphiæ*, who had the *nugnogen* in his poffeffion, may be found in *Valentini Amphitheat. Zootomicum*, II. p. 109. A bad figure of it may be feen in Rozier's *Obfervations fur la Phyfique*, XII. 1778, p. 277. See alfo, Tranfactions of the Swedifh Academy, Vol. V. p. 122, and Vol. VI. p. 116.

English

Engliſh fiſhermen ſtrongly recommend deſtroying it wherever it is found. But how comes this murderer into the ſhell? In all probability it creeps in when the animal opens its ſhell, and I thence conclude that the oyſters open their ſhells much wider than Reimarus * and others have imagined. Another queſtion is, How happens it that the ancient ichthyologiſts, though they mention this fiſh, do not obſerve that it was found in oyſter-ſhells, which at preſent is not uncommon?

Oyſters are leaneſt when they ſpawn, or after that period, and on this account fiſhing for them at that time is forbidden in England and other countries where prudent regulations prevail. In Spain this precaution is employed becauſe it is imagined that at this period the uſe of them as food is injurious to the health. It appears that they ought at leaſt to be three years old in order to ſerve as food †; and where care is taken for the preſervation of the oyſter-beds, the fiſhermen are ordered to ſcrape off all the ſmall ones which adhere to thoſe that are full grown, and to throw them back into the ſea. An old oyſter has often twenty ſmall ones attached to it. Very ſevere winters injure the oyſter-beds and deſtroy the oyſters, as was every where proved during that of the year 1740. Violent ſtorms in the ſpring are equally prejudicial, and many beds have been exhauſted by fiſhing up too many from them. We are told by Paulus Jovius ‡, that he remembered the time when oyſters were brought from the coaſt of Peſaro to Rome; but that theſe beds were afterwards entirely exhauſted, and that people were obliged to be ſatiſfied with oyſters brought from Corſica, which, before they

* Betrachtungen über die beſondern thieriſchen Kunſtriebe, p. 17.

† It is generally believed that the ſhells of muſcles receive yearly a new coat, and from the number of theſe their age may be determined, as the age of a tree from the number of its rings. But Poli, in his expenſive work on the Teſtaceous Animals of both the Sicilies, the firſt part of which was printed at Parma in 1791, aſſures us, that he obſerved that their ſize does not increaſe in ſuch a regular manner as to admit of their age being determined by it. In England the ſmalleſt oyſters are called oyſter-ſeed, *cultch* and *ſpat*.

‡ De Romanis piſcibus, cap. xli. p. 139.

arrived, were often in a putrid ftate. No kind of animal fubftance, indeed, is more liable to corrupt than fhell-fifh, both thofe which are ufed as food, and thofe which are not.

It is an undoubted truth, that the nature of the fhell and fifh, as well as the goodnefs of thefe animals, are different according to the bottom where they are found; fo that fifhermen can tell by their external appearance, and connoiffeurs by the tafte, where any kind of oyfter, and in general of fhell-fifh, have been found. Where the bottom is calcareous, they are tenderer and more friable; where it confifts of rock, they are thicker, more folid, and heavier; where it confifts of marl, or a mixture of chalk and clay, they are lefs earthy, fofter, and contain more animal gluten. On a flimy bottom they are more oily, and abound more with rich animal particles. The tafte is equally liable to change: for example; on the eaftern ftony fhore of the Adriatic Sea all marine animals are poorer and more infipid than thofe on the weftern fide, where the bottom is richer. On calcareous rocks the oyfters are larger, but have not fo good a tafte as thofe which live in flimy bays or creeks. In Norway thofe are leaft efteemed which are found on a muddy bottom, becaufe they have a muddy tafte: thofe of Denmark, found on a fandy bottom near Tondern and Fladftrand, are much better. The beft are the fo called rock-oyfters, found on the rocks where they are alternately covered and left dry by the tide, though in England thofe found at the greateft depth in the fea are preferred. The rock-oyfters are larger and plumper than others, but their fhells much thinner, and many of them fo thin that they are as tranfparent as horn. For this reafon, a cafk fuch as thofe ufed at Bergen will contain fcarcely 400, or even 300, fand-oyfters, but is capable of containing from 700 to 800 rock-oyfters.

The oyfter fifhery is exceedingly fimple, and requires very little apparatus; many collect the oyfters with their hand, that is, where the fea retires and leaves the bottom dry. Where this is not the cafe, a fquare iron box, or box bound round with iron, is dragged over the bottom by means of a rope, and from time to time drawn up and emptied.

Others,

Others, inftead of this box, have a net made of ftrong leather thongs, kept open by means of a heavy fquare iron frame, which, by being dragged on the bottom, rakes up the oyfters and fuffers them to be received into the net. Others have a rake with about twenty ftrong iron crooked and blunt fpikes eight or ten inches in length, which is faftened to a long thin elaftic pole. The fifhermen, who are in a boat, draw this rake over the bottom in the fame manner as the before-mentioned net, and thus raife the oyfters, which are retained by a board faftened over the rake, fo that they can be drawn up with it. The pole muft be fufficiently pliable to yield when drawn with force over the inequalities of the bottom. In places where the fifhermen employ more care in collecting the oyfters in order to fpare the banks, they pull up, by means of wooden tongs, when the water is clear, only the largeft oyfters, and fuffer the reft to remain undifturbed till they grow to the proper fize. There may, however, be other means employed for catching oyfters with which I am not acquainted; and it would be a ufeful labour if any perfon would give a complete treatife on the oyfter fifhery, with engravings of all the apparatus and inftruments. This, as far as I know, no one has ever yet done. Duhamel promifed to treat of this fubject in his large work on Fifhing, but he died before it was completed.

Thofe oyfters which are diftinguifhed by a green colour, and which the Dutch on that account call *groenbaardjes*, are confidered to be fuperior to others. But this diftinction is not natural to them, and is produced by art. For this purpofe pits are dug on the fea-fhore, and furnifhed with fmall fluices, through which the fea-water is fuffered to enter at the time of the fpring-tides. When the water has rifen to a certain height the oyfters are thrown into the pits, where they are left till they acquire the proper colour. This ftagnant water, in warm weather, foon becomes green, and in a few days the oyfters affume the fame colour; but they do not acquire their full quality, and become fit for fale, till the end of fix or eight weeks. I am inclined to think that this colour is occafioned by certain plants which grow in the water, perhaps an *ulva, conferva*, or *tremella*. This was the opi-

nion of Bradley *, who calls the plant a ſort of cow's milk; a name which, according to Hudſon's *Flora Anglica*, is a *Conferva rivularis*. I muſt here remark alſo, that the *Ulva latiſſima* of Linnæus, which by Gmelin in his *Hiſtoria fucorum* is called *Fucus tremella lactuca*, is by the Engliſh called the oyſter-green. The objections which ſome Engliſh writers have made to this opinion ſeem to me to be of little weight. They aſſert, that when, in the neighbourhood of a *greening-pit*, another is formed at the diſtance of about a foot, the water never becomes green in the latter; and that pits which have been a certain time green, and have communicated that colour to oyſters, ſometimes loſe their colour. But all this, even if true, might, on more accurate obſervation, be explained from the vegetation of theſe plants.

In Europe the Engliſh oyſters are accounted the beſt; and theſe, as the French believe, have been produced from oyſters formerly fiſhed up in Concalle Bay, near St. Malo, and tranſplanted to the Engliſh coaſt: but of this aſſertion we have no proof †. Thoſe, however, are moſt eſteemed which are found on the coaſt of Eſſex: from that coaſt the brood is tranſplanted to the ſea near Colcheſter, where the Coln, which flows through the city, forms a great many arms and ſmall creeks exceedingly proper for breeding them. A great many of theſe oyſter-pits are found at the village of Row Hedge, in the pariſh of Eaſt Doniland; and the ſale of oyſters forms a conſiderable branch of trade to the whole neighbourhood ‡. After the month of May, however, no ſeed muſt be taken from the banks, becauſe it is known, from experience, that in that caſe muſcles and cockles would breed there and deſtroy the oyſters. People who infringe on this regulation are ſeverely puniſhed by the Admiralty Court, which has all the oyſter banks under its inſpection. All theſe oyſters are in high requeſt, under the name of Colcheſter oyſters. The beſt come from Purfleet; they are exceedingly

* A Philoſophical Account of the Works of Nature, *London* 1739, 8vo. p. 72.

† Lettres de l'Abbé Le Blanc ſur les Anglois et les François, *Amſterd.* 1747, 12mo. Vol. III. p. 281.

‡ Morant's Hiſtory and Antiquities of Eſſex, *London* 1763, fol. p. 186.

plump,

plump, and the shells are thin and almost transparent. The best kind, however, even at Colchester, are so dear that a peck costs five or six shillings; and as the London fishmongers buy almost all their oysters from the fishermen or dredgers immediately after they are caught, they all, of course, pass through their hands. But they are accused of mixing fresh with stale oysters, and of selling those of the western coast for Colchester oysters.

Many, however, prefer those oysters which are collected on the coast of Dorsetshire, and particularly those found near Pool. They are said also to contain sometimes pearls of larger size than those found in other places. The greater part of the English oysters, which the Dutch carry away every year with more than a hundred vessels, are sold by the fishermen at Feversham, a small town in Kent, to the north-west of Canterbury, and which, like the neighbouring small towns of Milton and Middleton, is known on account of this trade. There are a great many oyster banks also in the Isle of Wight: those, likewise, are well known which are found near Tenby on the coast of South Wales, and near Milford-Haven: but the largest, and perhaps the worst, are those of Blackrock, near Liverpool.

It appears that the English have taken more trouble than other nations, not only to maintain their oyster banks, but to form new ones. Since the year 1712, a great many oysters have been found in the small channel of Meneu or Menai which separates Anglesey from Caernarvonshire, and where about the year 1700 none were to be seen. It is known, however, that soon after that period some person threw into the above channel about a hundred oysters, which have now extended several miles, so that at present a great many vessels are employed in this fishery *. It would appear that the waves carry the seed along with them, as it is known that on the coast of Holstein the banks are destroyed by violent storms about the time the oysters spawn.

[To be continued.]

* Some account of the English oyster banks may be found in the Transactions of the Swedish Academy, Vol. V. p. 122. and Vol. VI. p. 116. Also in the *Journal Economique* 1753, Dec. p. 166 and 179; and 1757, p. 177. See also the History and Antiquities of Colchester, by Phil. Morant, *Lond.* 1748, fol. Vol. I. p. 87; and Sprat's Hist. of the Royal Society, *Lond.* 1722, p. 307.

II. *History*

II. *History of Astronomy for the Year* 1799. *By* JEROME LALANDE. *Read at the Lyceum on the 26th of December.*

[Concluded from Page 41.]

THE Geographical Ephemerides of M. Von Zach, which appear every month, have continued to establish a valuable correspondence between the astronomers of Germany and those of the rest of Europe; but this work seems to have done more by procuring to astronomers new amateurs and new assistants in regard to observations and calculations; such as Colonel Le Coq, of Minden, in Prussia; M. Felgenhauer, at Reichenback, near Schweidnitz, where he has established an observatory furnished with excellent instruments; M. Berhrnauer, at Budissin or Bautzen, in Lusatia; M. Grillo, at Wettin, in the duchy of Magdebourg; and M. Gauss, at Brunswick, a young man who shews great taste and zeal for astronomy, and who has made useful calculations.

In Russia, two officers of the navy have been sent to determine the position of various points on the White and Frozen Seas. The President of the Academy, Baron de Nicolay, a German from Strasburgh, and a poet, seems to be interested in this undertaking.

The beautiful instruments of Megnié, among which are an azimuth quadrant, have been purchased by C. Lubbert, of Hamburgh; and he has given me some hopes that he will establish an observatory, where they may be rendered useful. The Senate of Hamburgh having resolved to cause a correct map of its territory to be made, M. Horner has set out from Gotha, where he laboured in the observatory, and has gone to Hamburgh.

The Duke of Gotha has purchased new instruments for his beautiful observatory, and M. Von Zach continues the printing of a valuable work, in two volumes quarto, on the Stars; which will soon appear.

In the Batavian Republic, C. Calkoen has gone to take possession of the observatory of Leyden, and has left that of Amsterdam to C. Keyser; but we have received no observations except from C. Dutenhove at Utrecht. The last men-

tioned astronomer has caused to be printed the Cosmologic Letters of Lambert, translated by C. Darquier.

A grand telescope of 25 feet has been constructed by Dr. Herschel for Spain; it cost 175,000 francs, (above 7000 *l.* sterling); but there is no observatory at Madrid; that of Buen-retiro is not yet finished. The minister Floridà Blanca had much at heart a museum and observatory, but the architect finished neither of them. When the war broke out, the minister was dismissed, and astronomy in Spain has remained in its former state of torpor. There is so little money in that country, that it is difficult to find enough to defray the smallest expences. But the minister Durquïjo seems to be much disposed in favour of astronomy, and, in the mean time, has enabled M. Chaix to make useful observations. I have thanked him in the name of Astronomy, and he returned such an answer as increases my hopes.

M. Chaix has been charged in Spain with a labour on measures; and we have sent him from Paris an account of what was done by Borda, Mechain, and Cassini, in regard to the measure of the pendulum, which in 1792 was found to be 36 inches 8 lines 60 at 10°, which is the mean heat at Paris. This supposes the pendulum in vacuo reduced to very small arcs. We learn from the Journal of Jena, that the first volume of the Memoirs of the Academy of Lisbon was published in 1797; it begins at 1780. It contains observations made at Lisbon by M. Custodio Gomes de Villasboas, and M. Ciera; by M. Ceruti at Carthagena, and by M. Dorta and Barbosa at Rio-Janeiro; meteorological observations made at Rio-Janeiro; observations of the satellites, made at Mafra; an eloge of d'Alembert, by M. Stockler; but this eloge has excited persecution against the author in a country where the anti-philosophic tribunal still calls itself the Holy Inquisition.

An able artist at Florence, named Gori, has divided, with great ingenuity, a quadrant belonging to the observatory of P. Ximenez, occupied by the Scolopies, and which had originally been very ill divided. We may hope, therefore, for some observations from Tuscany.

The revolution of Naples has made that capital, the po-

sition of which was not accurately known, an object of attention. M. Cassella sent me several observations of eclipses, which I have calculated; and I have found the distance of Naples from the meridian of Paris, by the mean of seven results, to be 47′ 49″.

The labours of M. Piazzi, of Palermo, must have been interrupted this year by calamity and misfortunes; for I have received no letter from the beautiful observatory and the able astronomer of Palermo.

A Roman citizen has come to reinforce astronomy in France. C. Ciccolini requested leave to lodge in the College de France, in order to observe and make calculations along with us. He has displayed in this situation as much zeal as ability; and we are indebted to him for the calculation of eclipses of the sun observed in this century, of which there had before been no results. He has assisted us also to calculate a part of our immense collection of stars.

I announced last year that Cassini seemed disposed to tread in the steps of his ancestors. His father, who quitted the observatory at the fatal period of 1793, has announced his intention of residing at Paris; and the Institute has elected him a second time to a place in the department of astronomy, vacant by the death of C. Lemonnier.

C. Sorlin has joined us, and is calculating the longitudes, latitudes, and angles of position of six hundred stars, which form the fundamental catalogue of the principal stars which C. Le Français is publishing in the *Connoissance des Tems*, and which he has for several years been bringing to perfection. C. Sorlin has calculated also a new table of the spheroidal degrees according to the dimensions we have adopted.

C. Mougin has calculated the precessions of the 1500 stars in the *Connoissance des Tems* for the year 7, in centiemes and seconds; and he is calculating for 1800 and 1900 the precessions of the 600 stars of the fundamental catalogue.

C. Bernier of Montauban has sent us calculations of observations of Mercury and Venus made by C. Duc-la-Chapelle.

Several dissertations have appeared in the public journals on the question, whether the year 1800 begins the nineteenth century.

century. In 1700 there were many papers on the ſame ſubject; but it is ſufficient to conſider that centuries are counted like every thing elſe, from one to a hundred, and therefore it is 1801 that muſt begin the new century. The only thing that could occaſion this error is, the tranſition from 17 to 18 hundreds. It has appeared to many people that this is changing the century.

C. Taillardat has publiſhed a ſmall work entitled *Horloge du laboureur*, or an eaſy method to diſcover the hour of the night by the aſpect of the ſtars, with figures of the conſtellations, and the months when they are ſeen in the evening.

The Marine, which is intimately connected with Aſtronomy, has produced a memoir containing theoretic explanations of a trigonometrical chart for reducing the apparent diſtance of the moon from the ſun or a ſtar, to the real diſtance, and to reſolve other problems of navigation, by C. Maingnon, *lieutenant de vaiſſeau*. This memoir, and the chart by which it is accompanied, contain an ingenious, eaſy, and correct method of reducing diſtances with a ſcale and compaſs on one chart, inſtead of the great number which have been publiſhed by Margets; and the report which C. Leveque has made to the Inſtitute on this ſubject diſplays great erudition, and contains important reflections.

C. Leveque has publiſhed alſo, in the *Connoiſſance des Tems* for the year 10, an intereſting memoir on the uſe which may be made of the horary charts of Margets for reſolving problems, which the author had not in view, and which render them more intereſting than was imagined.

The *Bibliotheque Britannique*, an excellent journal, publiſhed at Geneva, contains an extract of ſeveral reports made to the Society eſtabliſhed in that city for the advancement of the Arts, on the going of a marine time-keeper, executed laſt year by two Genevan artiſts, Demole and Magnin, and ſubmitted by them for examination to that Society, who appointed a commiſſion to follow, at the obſervatory, the going of that time-piece.

It is in the form of a cylinder, three inches in diameter and 18 lines in height, and is ſuſpended horizontally in a double circle, after the manner of the marine compaſſes. It

 has

has a compensation balance, according to the principles explained in the same volume of the *Bibliotheque Britannique**. It is moved by a spiral spring rolled up in the form of a cylinder. The escapement is described in the same work, and illustrated with figures. All the frictions, both of the escapements and the parts of the machine, are performed on rubies either plain or pierced; and this essential improvement, which renders the use of oil unnecessary, had never before been carried to the same degree of perfection.

These able artists improved themselves by a residence of several years at Paris with Ferd. and Louis Berthoud: they afterwards united their talents at Geneva, to the great advantage of an art in which they have so eminently distinguished themselves. C. Magnin is now travelling through Spain, to which he has carried a time-keeper like that above described. They make also portable chronometers, with an escapement independent and a compensation balance, which go exceedingly well.

The art of piercing rubies, formerly carried from Geneva to England by Fatio, was a secret lost to the country in which it was invented. These artists have again naturalised it, for they cut and pierced themselves all the rubies they employed.

C. Louis Berthoud has also brought a workman to Paris, and he will do the same thing in future in regard to the chronometers with which he will enrich the navy. The minister has entrusted me with one, the exactness of which is of the utmost value for the correspondence of the five observatories of Paris.

I hoped that my aërial voyage, on the 25th of July 1799, would have procured me some knowledge respecting the scintillation of the stars and the nature of the atmosphere; but I was deceived by the person to whom I gave my confidence, and for whom I braved the public opinion. I was not able to ascend to a sufficient height, but this atmospheric promenade enabled me to make some useful remarks on aërial currents. On setting out from Tivoli the air appeared to me perfectly calm, and there did not seem to be the least wind, yet I perceived that the balloon advanced towards the east. I

* Vol. XII.

rose

roſe to the height of 250 toiſes, and advanced at the rate of ſix leagues *per* hour. The direction of the clouds, which I had examined before I ſet out, was, on the contrary, towards the weſt: thus I experienced, that when a local cauſe impels the lower part of the atmoſphere towards the weſt, that above takes its place, and proceeds towards the eaſt. Of the two balloons which I ſent off before me for the ſake of trial, one roſe to the height of 300 toiſes, and directed its courſe towards Monfort; the other roſe to about the height of 600 toiſes, and proceeded towards Rambouillet, which made ſix degrees of difference. Thus, in 300 toiſes the wind changed ſix degrees. By riſing, therefore, more or leſs, we ſhall one day be able to vary our direction. The inclined planes of C. Tetu Breſſi, at Bellevue, afford us the means of varying theſe directions much more; and I hope that a proof of it will be ſeen next ſummer.

A large balloon of nine feet, which was let off next morning, roſe much higher, and fell at Coucy, 23 leagues to the north-eaſt of Paris, having proceeded at the rate of eight leagues *per* hour. It directed itſelf towards Maeſtricht and Ruremonde, while the clouds were proceeding in the direction of Joinville and Conſtance towards the ſouth-weſt. Between the two directions one might have choſen for every part of Germany. Thus, the project which I had announced of going to Gotha was not chimerical, as aſſerted; nothing would have been neceſſary but to chooſe the height. The velocity of eight leagues *per* hour was indicated alſo by the excurſion of Garnerin on the 28th of Thermidor, year 6, who went from Roſni to Chalons in four hours. Twenty-four hours, therefore, would have been ſufficient to go to Gotha, which was the term of my deſires and my hopes.

My aëroſtatic globe turned ſix times, which ſhewed, that in a current of air of twenty feet in height, there is a ſenſible difference of force and velocity; but probably by riſing much higher, I ſhould have found more regularity.

I ſaw alſo, by the agitation of my barometer, that the ſtability of the boat was not ſufficiently conſtant to enable me to obſerve it with my glaſſes; but at a greater height I ſhould, without doubt, have found more ſtability: beſides, as on

board ſhip, we might employ inſtruments, which would obviate the inconvenience of motion.

There have been periods when an aſtronomer would have been glad to riſe above the clouds. Le Gentil went to India in 1760 to obſerve the tranſit of Venus: by the war he was deprived of an opportunity of obſerving that of 1761; he was obliged, therefore, to wait for that of 1769; but he was again diſappointed by clouds. He had travelled then ten thouſand leagues, and employed ten years for an obſervation which he did not make. If he had been in poſſeſſion of an aëroſtatic globe, this long voyage would not have been loſt to aſtronomy; and, as aſtronomers, we have reaſon to congratulate ourſelves on the noble diſcovery of Montgolfier.

The froſt, during winter, afforded an opportunity alſo for meteorological experiments. C. Fourcroy repeated that of the congelation of mercury: at 30 degrees it began to loſe its fluidity, and at 32 became ſolid.

It now remains for me to ſpeak of the loſſes which aſtronomy has ſuſtained this year. The firſt, and moſt remarkable, is the death of John Charles de Borda, on the 19th of February 1799. He was born at Dax on the 4th of May 1733. He was firſt in the light horſe, and afterwards in the engineers. In 1769 M. De Roquefeuil induced him to enter into the navy, where his mathematical knowledge might render him of more utility. In 1754 he was received into the Academy of Sciences, where he was always conſidered as one of the firſt geometers. In 1771 he undertook a voyage to America, in the Flora, with Verdun and Pingré. The reſults appeared in 1778 in two volumes quarto, the greater part of which were due to his labours. In 1774 he undertook a voyage to the Azores, the Cape Verd iſlands, and the coaſt of Africa. The manuſcript exiſts, and contains many obſervations, which render the publication of it deſirable. I do not ſpeak of his learned reſearches on the reſiſtance of fluids, which are in the memoirs of the Academy for 1763 and 1767, ſince I have nothing to recall here but what he has done for aſtronomy and the marine. But C. Lefevre Gineau will read publicly in the Inſtitute a more particular eloge of this illuſtrious academician. By ſerving

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in the American war with d'Estaing in 1777 and 1778, his health was impaired, but he still employed himself in useful labours. In 1778 he introduced into astronomy and the navy multiplying circles, invented by Tobias Mayer, of the importance of which no one had before been sensible. He brought them to perfection, and by these means rendered an essential service to astronomy and navigation.

In 1792 he invented instruments and methods for observing the length of the pendulum, with a precision before unknown; and metallic rules for measuring bases, intended to give the real length of the meridian. These instruments were of great utility for that great and important labour. As refractions were necessary in this labour, he made experiments and theoretical researches worthy of a great geometrician. They are preserved among his papers, and a large memoir by him is ready to be printed.

He caused to be calculated at his house, and at his own expence, the logarithms of the decimal parts of the circle, according to the new division into 400 parts; and defrayed the expences also of printing. The publication of it is impatiently expected.

I have published in my Abridgement of Navigation his new method for gauging vessels, together with the tables. He was inspector of the dock-yards: in this situation he was useful, and Government had the greatest confidence in his talents.

C. Lemonnier died at his seat at Herils, near Bayeux, on the 2d of April. He had been lost to us ever since the 10th of November 1791: three years ago I gave an account of his useful labours, but the last epoch of this memorable life ought to be consecrated in the present history. I wished to insert in the first volume of the *Histoire Celeste*, now printing, a part of the observations of my illustrious master: nothing would have been so desirable as to render this testimony to his memory, which would have been at the same time a testimony of my gratitude; but I was not allowed, notwithstanding my zeal and entreaties, to have any communication with his manuscripts: I do not know what will become of them in hands foreign to astronomy, and which seem as indifferent

different for the glory of a father as for the ſciences, which he cultivated for ſixty years with ſo much ſucceſs.

Joſeph Lieſganig, formerly a Jeſuit at Vienna, died at Lamberg, in Auſtrian Poland or Galicia, on the 4th of March 1799, at the age of 81. We are indebted to him for the meaſurement of degrees in Hungary and Auſtria in 1769. He came to ſee me when I paſſed through Venice in 1765, and I then admired his talents and zeal.

On the 24th of February we loſt Profeſſor Lichtenberg, at Gottingen, to whom we were indebted for the poſthumous works of Mayer in 1775.

M. Strnadt, (we pronounce Strenat,) the aſtronomer of Prague, long known by many uſeful obſervations, died on the 24th of September. Bernoulli, when he gave an account in 1776, in the firſt volume of his *Nouvelles Litteraires*, of the memoirs printed at Prague, announced that there were among them memoirs of M. Stepling, who was director, and, in ſome meaſure, founder of the obſervatory, and of M. Strnadt, who was his aſſiſtant. Since that time he never ceaſed to obſerve, as may be ſeen in the Ephemerides of Berlin, and in other works. M. David, his aſſiſtant in the obſervatory, has ſucceeded him as director.

We have learned alſo from Sweden, the death of I. H. Lindquiſt, Profeſſor of Mathematics at Abo in Finland, who has publiſhed, in the Tranſactions of the Academy of Stockholm, many intereſting memoirs.

On the 17th of November 1798, we loſt a valuable amateur of aſtronomy, the biſhop of Tranſylvania, Count de Batthiani, who eſtabliſhed an obſervatory at Carlſbourg, to which he has bequeathed 30,000 florins and a beautiful library. He was born on the 30th of January 1741, and was made biſhop on the 25th of January 1781.

The biſhop of Erlang (Agria) Count Charles Eſterhazi, founder of the obſervatory where M. Madaraſſy obſerved, died on the 6th of March 1799.

III. *On*

III. *On the various Effects produced by the Nature, Compression, and Velocity of the Air used in the Blast-Furnace. By Mr.* David Mushet, *of the Clyde Iron-Works. Communicated by the Author.*

[Concluded from Page 70.]

I HAVE explained the neceſſity of juſt proportions exiſting betwixt the area of the interior of the blaſt-furnace, the quantity of air thrown in *per* minute, and the quality of coal. The various modes of blowing, and their reſpective effects, deduced from ſtrict obſervation, were alſo attended to. We have now, 3d, to adduce examples where the various changes of the atmoſphere, as to heat and preſſure, occaſion the moſt ſenſible difference in the quantity of materials conſumed, and in the quality and quantity of metal produced.

It has been already demonſtrated, that the air in winter, by containing leſs moiſture, is more proper for combuſtion, and more calculated to produce carbonated crude iron, than the air exiſting at any other ſeaſon. From this ſuperior quality the manufacturer obtains advantages, which induce him to wiſh for a continuance of cool air throughout the whole year. Theſe effects are not, however, uniform; they depend greatly upon a light or heavy atmoſphere. The keener and more ſtill the air, the more rapid the combuſtion. During a ſevere froſt, the deſcent of the materials is facilitated from $\frac{1}{10}$ to $\frac{1}{15}$ more than in rainy or hazy weather, and at the ſame time the quality of the iron is rather improved than impaired. When a change from froſt to ſnow or rain takes place, the effects frequently become almoſt immediately obvious: the colour of the flame at the furnace-head is changed; the tuyre of the furnace inflames, and burns with great violence; the lava, as it flows from the notch of the dam-ſtone, becomes lengthened and tenacious; the form of it is changed, and the colour undergoes the moſt viſible alterations; the iron no longer retains its complete ſaturation of carbon, but flows out ſenſibly impaired of its fluidity, and, when cold, the privation of carbon is moſt evident by the examination of its fracture.

 When

When ſuch conſequences ariſe from the tranſition ſo frequent in winter from froſt to thaw, it will be eaſily conceived that the change effected during the milder and warmer months muſt produce proportionally additional effects. The increaſe of temperature by taking up, and holding in ſolution, a much greater portion of aqueous vapour, will account for the ordinary effects which are annually obſervable in every work. Where theſe pernicious conſequences approach to extremity, a ſolution of the phenomenon will likely be obtained by the examination of the blowing-apparatus. If air is fitted for combuſtion in proportion as it is free from watery ſolutions, we are not to expect ſimilar reſults from theſe blaſt-furnaces in ſummer, which are blown by air from the regulating cylinder, and thoſe blown by air from a water or air-vault. I have for years ſeen this fact verified, and ſuperior quantity and quality of iron during the hot weather, obtained from a furnace excited by means of blaſt, from the ſimple regulating cylinder, with a leſs proportion of fuel than from furnaces whoſe air was expreſſed by means of the water or air-vault. Obſervations thus made, where every day the effects of the different means could be juſtly eſtimated and compared, have led me to the following concluſion: That the quality of the air, as furniſhed us by nature in our atmoſphere, is uniformly more fit for the manufacture of crude iron to profitable account, when diſcharged ſimply by means of cylinders and piſtons, than when brought into contact with moiſture either in the water-vault or air-vault.

So imperfect has the quality of the ſummer air been found in this country for combuſtion, where the water-vault was uſed, that experiments have been made to repair the deficiency of effect by introducing ſteam into the furnace by means of an aperture above the tuyre. The inducing motive to this act, was a belief, that combuſtion was diminiſhed in conſequence of a diminution of oxygen gas during the ſummer; that, by introducing water upon a ſurface of materials ignited to whiteneſs, decompoſition would enſue, a larger quantity of oxygen would then be preſented to the fuel, and ſuperior effects, as to combuſtion, obtained in this manner than hitherto

therto wtneffed. The idea was ingenious, and, in its application to the manufacture of caft iron, original; but the whole train of facts, laid down in this and former papers, as to the effects of a fuperabundant quantity of oxygen, was overlooked. The event proved in the moft complete manner, and on a great fcale, the pernicious effects of moifture. The furnace gradually became cooled where the fteam entered; the heat, fet free by the decompofition of the water and the difengagement of oxygen, increafed to an alarming pitch a confiderable way up the furnace; the quality of the iron became brittle, and as white in the fracture as filver; the introduction of the fteam was ftill continued, the defcending materials were inftantly robbed of their heat to facilitate the decompofition of the water, and by-and-by the furnace clofed entirely over, and the experiment ceafed *.

This experiment, performed in a furnace 18 feet high, is a complete proof that heat is difengaged from bodies while they pafs from the fluid to the aëriform ftate. The firft inftant of the difcharge of fteam, a very confiderable portion of heat would be withdrawn from the fufing materials and united to the water. This, in its turn, would be ignited to whitenefs, and decompofed upon the metals and cokes, in a fuperior region of the furnace. The procefs continuing for feveral hours, the materials at the tuyre were at laft fo completely deprived of the caloric by the continual torrent of fteam, that they loft fluidity, cooled rapidly, and at laft became black. Had another aperture for fteam and for air been opened above thefe, now entirely fhut up by the confolidated materials, the fame effects would have been produced; the immenfe quantity of caloric, difengaged by the decompofition of the ignited water, would now approach nearer to the top of the furnace, another ftratum of fufing materials would again become confolidated, till in the end the whole furnace would be fet faft from top to bottom. From the introduction of fteam into the blaft-furnace, either as fuch, or under a fuperior degree

* The refpectable and ingenious author of this experiment is among the firft in the iron trade who devotes a liberal and fcientific education to the improvement of this favourite branch: from his fituation, talents, and opportunity, much may be expected.

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of expanſive force, the following important truths may be learned: That the quantity of oxygen which enters into our atmoſpheric compound is generally more fit for the manufacture of the ſuperior qualities of crude iron than any mixture which may be furniſhed by the addition of water: that, although the decompoſition of water, by furniſhing a ſuperior quantity of oxygen, and by throwing off a relative proportion of caloric, increaſes the effects of combuſtion immediately in the vicinity of this chemical analyſis; yet, as the water had previouſly abſtracted the heat neceſſary to its decompoſition from the inferior ſtrata, a greater quantity by no means exiſts in the furnace. The water, in fact, only ſerves as a medium to convey the heat from one particular ſpot, but, by attempting to fly off with it, meets decompoſition, and renders up not only the abſtracted heat, but that which was contained in the oxygen of its decompoſition.

4th, The compreſſion and velocity of the air diſcharged into the furnace, conſiderably affect the reſults of the ſmelting operations. In the conſideration of this ſubject, the various qualities of coals will be found to have an intimate connection with the area of the diſcharging-pipe and the compreſſion of the blaſt. It has already been more than once obſerved, that a ſoft or mixed quality of coal is more ſuſceptible of combuſtion than either the ſplint or clod-coal: the conſequence of this is, that, unleſs the neceſſary compreſſion of air is uſed, decompoſition is too early accompliſhed, and the cokes become oxygenated by combuſtion in a greater ratio than is proper for the carbonation of the metal. To avoid this, the column of air ought to be diſcharged, in the caſe of ſoft coals being unavoidably uſed, under ſuch a degree of compreſſion, as to reſiſt entire decompoſition in the ignited paſſage. In that caſe, the iron does not ſo immediately come into contact with oxygen, as the decompoſition is chiefly effected in the ſuperior ſtrata of the ſeparating materials. Under the former circumſtance, of a looſe unconnected ſtream of air being thrown upon cokes eaſily combuſtible, the quality of the metal, with the ſame quantity of fuel, becomes oxygenated, the tuyre becomes fiery, and frequently emits ſparks of metallic oxyd. The ſeparating iron

may be viewed as it oozes from the ore in small globular masses, frequently on fire, changing its state to that of an oxyd. The combination of oxygen, by altering its density, makes it subject to the re-action of the blast, which at times gives it a direction from the tuyre with considerable violence. Those parts of the iron (by far the greatest) thus oxydated, which escape not at the tuyre, mix along with the fused earths of the ores and limestone, alter their colour, and flow from the furnace more unrevived than at their first introduction. It is, however, very different, even with this inferior quality of coal, where the density of the blast is proportioned to the inflammability of the fuel. Qualities and quantities of crude iron may be produced from this, equal to those from coals reckoned of a superior nature. The metal becomes as highly saturated with carbonic principle as that made from clod or splint coal. The tuyre evinces that decomposition is effected in its proper place. The fluid masses of iron, as they become expressed from the ore, are shivered into spray, before the dense column of air, without exhibiting the least symptom of decomposition. They again unite under the level of the blast, increase in size, and sink through the fluid stratum of earths to the bottom of the furnace. This fact holds out one of the strongest proofs of the great affinity which carbon and iron mutually possess towards each other. In the case of the iron separating in an oxygenated state destitute of carbon, it immediately falls a prey to its affinity for oxygen. In the latter case, the iron, being completely carbonated, resists decomposition by the sacrifice of a very small portion of its carbon: it further proves, that the affinity of oxygen is greater to carbon than to iron; and that, before iron becomes oxydated, all the carbon is taken up.

The continuity of the particles of splint coals renders the cokes of difficult combustion, capable of withstanding a most powerful discharge of air, in quantity and in the degree of compression, without entailing effects similar to those produced with the use of softer coals: this renders the operations with splint coal less subject to casualty and to change. Carbonated iron with a proper blast is more uniformly obtained, and frequently a very superior quantity. Similar effects

effects are produced with the clod coal, but in a more eminent degree. Discharging-pipes are used four inches in the diameter, and the compression only equal to two pounds on the square inch; yet the same fatal effects are not known as in the use of soft coal, which, with such a column of air, would require the pressure to be equal to $3\frac{1}{2}$ pounds upon the square inch at least.

5th, Upon the form and construction of the discharging-pipe effects of more considerable importance depend than is either generally allowed or even conceived. At some iron-works, no peculiar shape is adopted: if the tube is sufficient to convey the air, and the mouth of it nearly of the size wanted, the interior construction is entirely overlooked. This indifference, however, is by no means general: variously constructed pipes are used at different works, and at some places it is preferred to throw in the air from two pipes whose areas are only equal to one of the usual size.

The various shapes may, in point of the principle of their construction, be reduced to three. (See Plate V. Fig. 1, 2, 3.)

To understand properly the objectionable parts of the construction of nose-pipes, it must be recollected, that much has been said to depend upon the blast reaching the opposite extremity of the furnace, as little impaired of the compactness and velocity of its original discharge as possible. When it is otherwise, the results in the internal operations of the furnace must be consequently altered. If the compression is diminished $\frac{1}{2}$ or $\frac{2}{3}$ when it reaches the opposite wall, decomposition in that portion must be effected before the air has attained its elevated situation in the furnace. It is even possible to disperse the whole column of air in such a manner that the ignited materials of the opposite side may receive little of its effects to promote combustion.

The discharging-pipe Fig. 1. is frequently used: its length is 12 inches or more; the discharging aperture 3 inches, the other end 5 inches; but this is arbitrary, depending upon the size of the adjoining pipe. From a pipe thus constructed, the air disperses or diverges too suddenly; and at a small distance from the orifice, a considerable portion of it answers but imperfectly the purposes of combustion. Part of it is speedily decomposed, and the oxygen brought into immediate

 contact

contact with the iron. The quantity of metal is reduced by the former, and the quality injured by the latter. Though long custom, by a continued use of such shaped pipes, has prevented their pernicious effects from being observed, yet they must prove in many cases detrimental to the œconomical distribution of air, and the manufacture of iron.

Fig. 2. represents a nose-pipe, of another construction, even more exceptionable; because the air dispersing still more suddenly, in a degree somewhat proportionate to the more sudden contraction of the pipe, a considerable quantity never enters the furnace, but, striking on the exterior wall, is thence repelled.

A discharging-pipe constructed as in Fig. 3. would obviate, in a great measure, the imperfections of the two former: the length of the tapered piece is 12 inches, of the straight pipe, 6 inches; extreme diameter as in the others, 5 inches; diameter of straight pipe, 3 inches. From such a pipe it is conceived that the blast will proceed to the greatest possible distance unimpaired in compression and velocity. So far, therefore, as the absolute force of the blast and breadth of the furnace will permit, decomposition will be prevented on the level of the pipe, and the manufacturer freed from the evils which I have above detailed, as attendant upon decomposition in that quarter.

IV. *Communication from Mr.* HENRY CLUTTERBUCK, *Surgeon to the Universal Royal Dispensary, on the Cure of those Affections which arise from the Poison of Lead.*

To the Editor of the Philosophical Magazine.

SIR,

THE extensive circulation of your Magazine amongst the manufacturing classes of the community, appears to me to render it a proper vehicle for the following communication. Should you be of this opinion, your insertion of it will oblige,

Sir, your humble Servant,

H. CLUTTERBUCK.

Walbrook, March 7, 1800.

IN

IN the year 1794 I publiſhed a ſmall pamphlet* containing an account of the efficacy of *mercury* in removing the effects of the poiſon of *lead* on the conſtitution of thoſe employed in working with that metal. As the practice then recommended ſeems to me to have engaged leſs attention than its importance merits, I wiſh here to recapitulate, as briefly as poſſible, the facts then ſtated, and to add ſuch further obſervations as my ſubſequent experience has ſuggeſted relative to the ſubject.

I hardly need ſtate to you the great number of perſons who, in the courſe of their occupations, are employed about this poiſonous mineral; nor how large a proportion of theſe ſuffer the agony of colic, followed, in many caſes, by the loſs of the uſe of their limbs, diſqualifying them, in a ſhort time, from earning their ſubſiſtence. The white-lead manufactories, the work-ſhops of the plumber, the glazier, and the painter, afford too many proofs of the truth of this. The frequent inefficacy of the ordinary methods of treatment in thoſe caſes is well known. The ſuggeſtion, therefore, of a mode of relief more powerful than theſe, and, in recent caſes, almoſt certain, muſt be allowed to be a thing of no inconſiderable moment. Such a remedy, I venture to ſay, will be found in *mercury*. At the time of publiſhing my former remarks on the ſubject, I had tried its powers in eight inſtances only, in all of which it afforded the moſt ſtriking relief. The truth of this, I ſhould obſerve, did not then reſt on my own teſtimony alone, but was confirmed by that of the Phyſicians of the *Diſpenſary*, my colleagues at the time. The trials which I have ſince made and witneſſed, though not invariably attended with ſucceſs, have afforded ample proof of the powers of the remedy in queſtion, which Dr. Bradley, now Phyſician to the Weſtminſter Hoſpital, did not heſitate, in his letter to me on the ſubject, to call a *ſpecific* in thoſe diſorders.

The affections commonly induced on the body by the poiſon of *lead* are, violent colic, with obſtinate coſtiveneſs,

* Account of a new and ſucceſsful Method of treating thoſe Affections which ariſe from the Poiſon of Lead. Printed for Booſey, Broad-ſtreet, London.

relievable

relievable only by the moft active purgatives, and very frequently recurring; pains refembling rheumatifm, about the arms and fhoulders; head-ach; cramps of the legs, and oftentimes fevere fits of the gout in the extremities; palfied ftate of mufcles of the arms and hands, taking away all power of grafping any thing, and even of lifting the hand to the mouth; and, not unfrequently, epileptic convulfions.

The remedies commonly employed for the relief of thefe dreadful fymptoms are, purgatives of different kinds, efpecially *caftor oil*; volatile and ftimulating medicines of various forts; and the warm bath, particularly the *Bath waters*. Thefe often are of fignal fervice; but they are, likewife, often inadequate to afford relief, and the unhappy fufferer drags on a miferable exiftence. In a large proportion of thefe cafes, I think I am warranted in faying, *mercury* is an effectual remedy.

Calomel (a mercurial preparation) has been long in ufe for the relief of the colic and conftipation produced by *lead*; but it is as a purgative only that it has been employed, without regard to its effects on the conftitution generally. The object I have here in view is, to employ mercury in fuch a way as to produce the ordinary effects of this mineral on the general habit, characterifed by forenefs of the mouth, and tendency to falivation. It does not feem very material in what way, or with what particular preparation of mercury, this is brought about; as I have employed it, in the form of ointment, *externally* to the affected parts, and *inwardly* in various preparations, without obferving any material difference in the effects. For the relief of colic and obftruction of the bowels, calomel is, perhaps, the beft and moft commodious form; given in the quantity of a grain daily, it rarely fails, in a fhort time, to induce a regular action of the bowels, with the entire removal of pain. It muft be obferved, however, that the fyftem, in the cafes which have been defcribed, is peculiarly fufceptible of the irritation of mercury in all its forms; it is neceffary, therefore, to employ it with caution, and more fparingly than in fome other cafes. If the difeafe has been of long ftanding, it is requifite to keep up the mercurial action for feveral weeks, and to renew it, from

time to time, at ſhort intervals. Two or three months, and even a longer period, will be ſometimes required for the attainment of the deſired end.

I ſhall not diſguiſe, that, in caſes of long ſtanding, where the muſcles of the limbs are waſted and become rigid, and the joints ſtiff and unpliant, mercury, like all other means, will often be found ineffectual. A great obſtacle to the cure, too, frequently ariſes from the poverty and wretchedneſs of the objects: ill fed, and without ſufficient ſhelter againſt the inclemencies of ſeaſon, the conſtitution is unable to ſuſtain the debilitating action of the remedy. The effects of cold, as I have juſt hinted, influence materially the cure. In the winter ſeaſon, the uſe of the limbs is much more ſlowly recovered than in warm weather. This leads one to expect advantage from the warm bath in ſuch caſes; and, in fact, this is one of the moſt powerful remedies we poſſeſs, and is calculated greatly to aid the good effects of mercury. The *Bath waters* are very ſucceſsfully employed for the purpoſe, and the hoſpital there much reſorted to by patients of this deſcription.

If the advantages of the plan I have here recommended be more widely diffuſed, through the medium of your uſeful Miſcellany, I ſhall be highly gratified.

I am happy to find my obſervations on this ſubject lately confirmed by a reſpectable foreign writer. M. Warburg, of Berlin, in a Tract on Palſy, ſtrongly recommends the uſe of calomel and mercurial frictions in that ſpecies of the diſeaſe which is produced by *lead**.

V. *Obſervations on Spiders, and their ſuppoſed Poiſon.* *By* M. Amoreux *jun. M. D.*

[Concluded from Page 80.]

IT is well known that chickens, nightingales, and other birds eat ſpiders without ſuſtaining any injury: ſpiders have alſo been preſcribed as a remedy chiefly in the tympanis. All theſe inſtances, however, do not diſprove the obſerva-

* *De Paralyſi, Auctore* Jacobo Warburg, *Berolinenſi.*

tions

tions of thoſe who have ſeen diſagreeable conſequences from the pricking of ſpiders. Liſter is among this number; and Liſter muſt be believed, becauſe he made many obſervations on theſe inſects. This author ſays poſitively, in a particular treatiſe, that ſeveral ſpiders have a venomous liquor *. We are aſſured, on the other hand, by Robert Boyle †, that he never ſaw any venomous ſpiders in Ireland, notwithſtanding the prejudices of the people; but, out of reſpect for an author who had none for others, he durſt not controvert what Scaliger had advanced in regard to the ſpiders of Gaſcony, which, he ſays, are ſo venomous, that, when they are cruſhed with the feet, the venom penetrates the ſoles of the ſhoes.

The experiments of M. Bon, a member of the Chamber of Accounts of Languedoc, ſeem, however, contrary to the aſſertion of Scaliger. This magiſtrate, who endeavoured to apply to ſome uſeful purpoſe the threads of ſpiders, touched a great number of theſe inſects, and had been frequently bit by them without experiencing any bad conſequences. Hoffman, without doubt, went too far when he defied any one to prove that ſpiders or any other inſects, taken internally, ever cauſed the leaſt inconvenience to people in health. In this defiance there is, without doubt, ſome exaggeration. It is well known that the injury done to us by the greater part of inſects ariſes only from their ſting; but inſects of a cauſtic nature cannot certainly be ſwallowed with impunity. Though there have been people who ate ſpiders, diſagreeable conſequences have been ſeen to ariſe from the bite of theſe inſects. This depends on the kind of ſpider, the time, and the place. As there are poiſons which have more action when introduced through the ſkin than when taken internally, ſuch as that of the viper, I am inclined to think that the poiſon of the ſpider may have a contrary effect; it exerciſes a ſtronger action, perhaps, internally than on the ſkin. Punctures, indeed, are of little conſequence; and we are told of ſurpriſing effects by

* Araneas in ipſo morſu venenum ſuum dimittere, ideo mihi veriſimile eſt, quod ab unâ aliquâ hac beſtiolâ, à me laceſſitâ, lymphæ puriſſimæ ſimiles guttas exiguas decies et amplius intra breve tempus reſperſas notavi; idque totus factitavit quoties mordere voluit.

† Tentam. Phyſiol. p. 38.

ſpiders infuſed or bruiſed in wine employed with an intention of poiſoning. What is related on one hand, of ſpider-eaters, and on the other, of thoſe who have been poiſoned by drinking wine in which ſpiders have been infuſed, ſeems to be contradictory: but it, however, is not ſo: the difference ariſes, no doubt, from the difference of the ſpiders, and the different conſtitution of the ſubjects.

It is pretended alſo, that ſpiders diffuſe a noxious vapour when burnt, and that, when they burſt on being applied to a flame, they ſpurt out a noxious liquor. I ſhall here relate what is ſaid on this ſubject by Turner in his Treatiſe on the Diſeaſes of the Skin *. "When a young practitioner," ſays he, "I was ſent for to viſit a woman who had been accuſtomed, every time ſhe went to the cellar with a candle, to burn all the ſpiders' webs which ſhe could find. It happened, however, that one of theſe inſects ſold its life much dearer than the reſt. Its feet having got entangled in the tallow, and its body burſting, its venom and juices were thrown out into the eyes of its perſecutor, and particularly on her lips. The latter ſwelled up prodigiouſly in the night-time; one of her eyes became exceedingly inflamed, and her tongue and gums were alſo affected. At laſt theſe affections were accompanied with continual vomiting, &c. I ordered at firſt a ſmall glaſs of Spaniſh wine burnt with a ſcruple of ſalt of worm-wood, and ſome hours after a bolus of theriac, which ſhe afterwards threw up. I rubbed her lips with oil of ſcorpions and oil of roſat, &c.; I applied leeches to the temples, by which the inflammation of the eye was much diminiſhed; and I allayed the pain by the uſe of a very bright mucilage of the ſeeds of quinces and white poppies, extracted in roſe-water. But as the ſwelling of the lips ſtill increaſed, I applied a cataplaſm, made with a decoction of ſcordium, rue, and elder-flowers, thickened with the farina of vetches, &c." The author, however, notwithſtanding his care, had not the honour of performing a cure. An old woman, as is often the caſe, interfered, and had all the glory, after fifteen days application of the leaves and juice of plantain, and ſpiders webs. Turner relates that before this accident, the patient had

* Vol. II. p. 292. of the French edition.

told

told him, the ſmell which aroſe when ſhe burnt ſpiders in that manner had often affected her head ſo much, that ſhe thought the objects ſhe ſaw turned round. She often even experienced fainting fits with cold ſweats, and ſometimes a ſlight vomiting. But notwithſtanding all this, ſhe found ſo much pleaſure in tormenting theſe poor inſects, that nothing could cure her of her mania till ſhe met with the accident above mentioned. This leſſon may ſerve as a warning to thoſe who have the ſame mania, and who, beſides expoſing themſelves to injury of the like kind, run the riſk of burning their apartment, or perhaps the whole houſe.

The punctures made by large ſpiders (I here allude to thoſe of France) are almoſt inſenſible. There is formed around the wound a livid ſwelling, ſometimes with phlyctenes, which ſeem to announce a ſeptic poiſon. The other ſymptoms, deſcribed by different authors, are ſo various, that, if they were united in the ſame ſubject, the poiſon of the ſpider would be the moſt violent of any known. It is ſurpriſing how the ancients have aſſigned particular ſymptoms to characteriſe the puncture of each kind of phalangium and ſpider. One might be induced to believe that they obſerved an analogy or relation between our humours and the colours of theſe inſects: they have marked all the degrees of pain, from itching to ſtupor. On this ſubject the reader may conſult Paulus Ægineta, Avicenna, Rhazes, Nicander, Grevin, &c. Afterwards a whole cloud of authors repeated that the venom of ſpiders, introduced into the body in any manner whatever, was followed by numbneſs of the part, cold of the extremities, ſhivering, ſwelling of the lower belly, paleneſs, involuntary ſhedding of tears, and an inclination to make water; priapiſm in young perſons, relaxation of the ſame member in old people, convulſions, &c.

It is very uncommon to ſee conſequences ſo fatal, unleſs people have the misfortune to be bitten by the avicular ſpider of America, which deſtroys birds' neſts; or by the black ſpider of Madagaſcar, which, according to Flacourt, occaſions ſhivering, and cools the blood; or, in the laſt place, by the *tunga*, the wolf-ſpider, and *nhamduguaſu*, which are ferocious ſpiders of Braſil, mentioned by Lecluſe and Margraff. Merian

Merian has given a figure of the large hairy fpider of Guajava, which lives on the colibris.

Brogiani affures us, that in Etruria there is a kind of phalangium which refides in the earth, the puncture of which occafions violent fymptoms; fuch as phrenitis, vomiting, gangrene in the wounded part, or exanthemata. Sheep alfo have died in confequence of being punctured by this infect. Brogiani does not here allude to the tarantula, as he treats of that infect feparately. The Italian journals, fome time ago, announced that a large kind of fpider had occafioned great ravage in the fields of Volterra, in Tufcany. It attacked the reapers, and, by its puncture, occafioned violent pain and convulfive movements in all the limbs. Nothing of the like kind is to be apprehended in France, except in fome cantons during the dog-days. An enlightened naturalift, the Chevalier de Lamanon, fays, that in the month of June 1782 the drought and heat were fo great in Provence, that fpiders, which in general are not venomous, occafioned by their bite fevere difeafes, which had a great refemblance to thofe occafioned by the bite of the tarantula. In ordinary cafes of being bit or punctured by fpiders, it will be fufficient to wafh the wounded part with brine, to apply theriac, and to prefcribe one or two dofes internally. The frefh leaves of fage, or thofe of the plantain, have been recommended as topics, and wafhing with vinegar. Recourfe alfo may be had to volatile alkali.

VI. *A curfory View of fome of the late Difcoveries in Science* *.

MATHEMATICS.

LA PLACE, in his *Mecanique Celefte*, has confidered the fyftem of the world as a grand problem of mechanics, which he has endeavoured to refolve. For this reafon he treats in the firft book on the general principles of equilibrium and motion. He gives a rigorous demonftration of the principle of

* From the *Journal de Phyfique*, an. 8.

of the decompofition of forces. He then treats of the motion of a folid body, whatever be its figure; gives the conditions of the motion of fluids, and applies them to the motion of the waters of the fea and to that of the atmofphere. He then determines what ought to be the force acting on the celeftial bodies to render their movements fuch as they are exhibited to our obfervation. The laws of Kepler conduct him directly to the principle of univerfal gravity; that is to fay, that the action which the celeftial bodies exercife on each other is in the direct ratio of their maffes and the inverfe of the fquare of their diftances. The new illuftrations which he gives are highly worthy the attention of geometricians.

Foffombroni has treated the principle of virtual forces like an able geometrician.

ASTRONOMY.

Herfchel has publifhed his obfervations on the fatellites of Jupiter, in which he determines the length of their days, or their revolutions round their axes. The firft turns round its axis in 1 day 18 hours 26′ 6″; the fecond in 3 days 18 hours 17′ 9″; the third in 7 days 3 hours 59′ 6″; and the fourth in 16 days 18 hours 5′ 1″. He endeavours to determine the fize of thefe bodies, but has not yet been able to attain to great accuracy. "We may only conclude," fays he, "that the firft fatellite is larger than the fecond; that the fecond is the fmalleft of all; that the third is much larger than any of the reft; and that the fourth is nearly as large as the firft."

Le Français Lalande continues with perfeverance his catalogue of the ftars of our hemifphere. He has already carried the number to 49,000.

Bouvard has completed a grand labour on the movements of the moon. He has calculated the eclipfes mentioned by Ptolemy, and thofe obferved by the Arabs. All thefe eclipfes, compared with modern obfervations, have given him 12″ 21 of correction for the fynodical motion, and 8′ 34″ 5 for the mean anomaly. This agrees with the refults which Laplace has found by calculation.

 The

The French aftronomers have at length terminated the grand operation of meafuring an arc of the meridian from Dunkirk to Barcelona. They performed this labour with fuch precifion, that no fenfible error can be fuppofed in it, efpecially as their refults are abfolutely agreeable to thofe given by preceding meafurements. It appears from their labour, that the quarter of the terreftrial meridian, that is to fay, the arc of the meridian comprehended between the Equator and the North Pole, is = 2,561,370 modules, (they have employed this word to exprefs a rule of platina of twelve feet, or two toifes,) which make 5,122,740 toifes. The metre is the ten millionth part of this quantity; that is to fay, the length of the metre is $\frac{256537}{10000000}$ parts of the module; and, by comparing this with the ancient meafures, the true metre is 443 $\frac{296}{1000}$ lines of the toife of Peru, (that is to fay, of that which ferved the French academicians for meafuring a degree in Peru,) the temperature of this toife being fuppofed to be 18° of Reaumur, or 16$\frac{1}{4}$ of the centigrade thermometer. The metre, therefore, is 3 feet 11 $\frac{296}{1000}$ lines.

They have calculated alfo the length of the degree for the different latitudes which they meafured. The following is the refult:—

	modules,	toifes.
The degree between Dunkirk and Paris in the mean latitude of 49° 56′ 30″, is -	28538 or	57076
Between Paris and Evaux, in the mean latitude of 47° 30′ 46″ - - -	28533 or	57066
Between Evaux and Carcaffonne, in the mean latitude of 44° 41′ 4″ - - -	28489 or	56978
Between Carcaffonne and Montjouy, in the mean latitude of 42° 17′ 20″ - -	28472 or	56944

This length of the arc of the meridian is the fame as that before determined by obfervations. The following is the account given of it by Lalande*:

" In obferving carefully with a fextant the zenith diftance of the fame ftars at Paris and at Amiens, there has been found 1° 1′ 13″ of difference in all the altitudes between two points, the diftance of which deduced from the preceding was 58233 toifes. Nothing remains, therefore, but to make

* See his Aftronomy, third edition, No. 2661.

the

the following proportion: 1° 1′ 13″ is to 58233 toises as 1° 0′ 0″ is to a fourth term, found to be 57074 toises. This is the length of a degree of the earth between Paris and Amiens, determined by Picard. The mean latitude of this degree is 49° 23′. This length supposes the toise of the north, and the temperature of Reaumur's thermometer, 10 or 12°. This degree is reduced to 57056 with the toise of the equator now adopted."

It is to be observed, that according to these new measures the difference of the degree between Evaux and Carcassonne is much greater than it ought to be according to theory; for it differs 88 toises from that between Paris and Evaux, though there is only a difference of about three degrees of latitude, which makes nearly 32 toises *per* degree. That between Carcassonne and Mountjouy differs 34 toises, though there is only a difference of about two degrees of latitude, which makes 14 toises *per* degree; while the degrees between Dunkirk and Paris differ but 10 toises, and there are two degrees of latitude, which makes only four toises of difference *per* degree.

It is generally supposed that the degree under the equator is 56753 toises, as it has been estimated by the French academicians, and that under the polar circle, it is 57419 toises, which would make a mean difference of about seven toises between each degree. But it appears that the difference is a little greater between the degrees towards the pole, than between those towards the equator. The difference of 14 and 32 toises, which has been lately found, cannot be reconciled with general theory. This difference, therefore, must depend on some particular causes. These facts indicate either an irregularity in the terrestrial meridians, or an ellipticity in the equator and its parallels, or an irregularity in the interior of the earth, or an effect of the attraction of mountains, or a powerful action of these different causes united, or of some of them on each other; an action which has never been demonstrated in so striking a manner as by the results just given. It must be left to the ablest mathematicians to direct their attention to these facts in order that they may endeavour to explain the principles on which they depend,

 and

and to attain, refpecting the figure of the earth, a more perfect theory than any yet given. This confirms the opinion before entertained, that the figure of the earth is not a regular curve. It refults from thefe calculations, that the flatnefs of the earth is a 334th part; that is to fay, the axis is to a diameter at the equator as 333 to 334.

The length of the pendulum is another mean given by Nature for obtaining conftant meafures, becaufe it is a confequence of gravity which cannot vary. It has been eftimated for a pendulum, vibrating feconds at Paris, to be $\frac{2540912}{10000000}$ of the module, or $\frac{993827}{1000000}$ of the metre.

The length of the metre being determined, ferves to fix the weights and meafures of capacity. Diftilled water was affumed as the body which could be moft eafily procured in full purity; and Lefevre Gineau endeavoured to afcertain the weight of a kilogramme of this water taken at that temperature at which it has moft denfity. The real kilogramme, the weight of a cubic decimetre of diftilled water, taken at its maximum of denfity, and weighed in vacuo, or the unity of the weights, is 18827, or 2 pounds 5 gros 35 0·15 grains; that is, a little more than the Paris pint, which was fuppofed to weigh two pounds. According to thefe experiments, the cubic foot of diftilled water, taken at its maximum of denfity, is 70 pounds 223 grains. It is 70 pounds 141 grains if we take the water at the temperature of $\frac{3}{10}$ of a degree; and it would be 70 pounds 130 grains, if we fhould take the water at the temperature of melting ice. The maximum of the denfity of water, and therefore of its weight, is, when its temperature is at about 4 degrees. The kilogramme contains a thoufand grammes, confequently the gramme is 18 $\frac{827}{1000}$ grains.

90th Comet. The nucleus of the comet, difcovered by Mechain at the obfervatory of Paris about two o'clock in the morning on the 20th of Thermidor (Auguft 7th), between Gemini and the Lynx, was exceedingly fmall, was furrounded by a light nebulofity, and had no traces of a tail. The diameter of the whole was only about a minute. It rofe towards the north to about 60 degrees of declination. The elements of its orbit were as follows:—Longitude of the

 defcending

descending node; 3 signs 9° 34′: place of the perihelion in the orbit, 3° 36′: inclination of the orbit, 50° 52′: direction of its movement, retrograde: passage at the perihelion on the 21st of Fructidor, year 7, (Sept. 7, 1799,) at 4 hours 34 minutes mean time at Paris: distance of the perihelion 0·82387.—This is the tenth comet discovered by Mechain.

LUMINOUS FLUID.

Fabbroni has examined the refractive power of various fluids, and shown that they are exceedingly different. Thus, æther has a refractive power much more considerable than oil. The former gives a focus of 60, the latter of 75.

Haüy has shown that several mineral substances have a double refraction; such as, transparent quartz, the topas, the emerald, calcareous spar, sulphat of barytes, the euclase, the idocrase, sulphat of strontian. Among the soluble and sapid salts, borat of soda (borax) and sulphated magnesia have double refraction; sulphur has double refraction; amber and the diamond have single refraction; carbonat of lead, or white lead ore, has double refraction.

Brougham, in a paper printed in the Transactions of the Royal Society, gives an account of some experiments which seem to him to prove that the doctrine of Newton respecting the refrangibility of the rays of light, is false. Prevost, of Geneva, thinks that Brougham is mistaken: he maintains the theory of Newton, and shows that the experiments opposed to it are not conclusive.

Dizé has considered the matter of heat as the cause of all luminous effects. He has made a great number of experiments to prove, that in all the terrestrial phenomena there is never light without heat. His conclusions are: 1. That heat always precedes luminous effects. 2. That light cannot be a body *sui generis*; because light does not take place but when caloric is free, and in sufficient accumulation, on which depends the force of the luminous effect produced. 3. The effect called luminous can only be a luminous property, which every molecula of free caloric possesses. 4. Caloric being a substance, the quantity of which is limited, darts itself towards the sun, which is its strongest point of attrac-

 tion.

tion. 5. When the moleculæ of caloric are accumulated in that body, they are thrown off from it by the force of repulsion; and from this results the sublime harmony of attraction and repulsion, the only cause of the equilibrium of the universe.

[To be continued.]

VII. *On the Combustion of the Human Body, produced by the long and immoderate Use of Spirituous Liquors. By* PIERRE-AIME LAIR *.

IN natural as well as civil history there are facts presented to the meditation of the observer, which, though confirmed by the most convincing testimony, seem on the first view to be destitute of probability. Of this kind is that of people consumed by coming into contact with common fire, and of their bodies being reduced to ashes. How can we conceive that fire, in certain circumstances, can exercise so powerful an action on the human body as to produce this effect? One might be induced to give less faith to these instances of combustion as they seem to be rare. I confess that at first they appeared to me worthy of very little credit, but they are presented to the public as true by men whose veracity seems unquestionable. Bianchini, Maffei, Rolli, Le Cat, Vicq-d'Azyr, and several men distinguished by their learning, have given certain testimony of the facts. Besides, is it more surprising to experience such incineration than to void saccharine urine, or to see the bones softened to such a degree as to be reduced to the state of a jelly? The effects of this combustion are certainly not more wonderful than those of the bones softened, or of the diabetes mellitus. This morbific disposition, therefore, would be one more scourge to afflict humanity; but in physics, facts being always preferable to reasoning, I shall here collect those which appear to me to bear the impression of truth; and, lest I should alter the sense, I shall quote them such as they are given in the works from which I have extracted them.

We read in the Transactions of Copenhagen, that in 1692

* From the *Journal de Physique*, Pluviose, year 3.

a woman

a woman of the lower claſs, who for three years had uſed ſpirituous liquors to ſuch exceſs that ſhe would take no other nouriſhment, having ſat down one evening on a ſtraw chair to ſleep, was conſumed in the night-time, ſo that next morning no part of her was found but the ſkull and the extreme joints of the fingers; all the reſt of her body, ſays Jacobæus, was reduced to aſhes.

The following extract of the memoir of Bianchini is taken from the Annual Regiſter for 1763:—The Counteſs Cornelia Bandi, of the town of Ceſena, aged 62, enjoyed a good ſtate of health. One evening, having experienced a ſort of drowſineſs, ſhe retired to bed, and her maid remained with her till ſhe fell aſleep. Next morning, when the girl entered to awaken her miſtreſs, ſhe found nothing but the remains of her body in the moſt horrid condition. At the diſtance of four feet from the bed was a heap of aſhes, in which could be diſtinguiſhed the legs and arms untouched. Between the legs lay the head, the brain of which, together with half the poſterior part of the cranium, and the whole chin, had been conſumed: three fingers were found in the ſtate of a coal; the reſt of the body was reduced to aſhes, which, when touched, left on the fingers a fat, fœtid moiſture. A ſmall lamp which ſtood on the floor was covered with aſhes, and contained no oil; the tallow of two candles was melted on a table, but the wicks ſtill remained, and the feet of the candleſticks were covered with a certain moiſture. The bed was not damaged; the bed-clothes and coverlid were raiſed up and thrown on one ſide, as is the caſe when a perſon gets up. The furniture and tapeſtry were covered with a moiſt kind of ſoot of the colour of aſhes, which had penetrated into the drawers and dirtied the linen. This ſoot having been conveyed to a neighbouring kitchen, adhered to the walls and the utenſils. A piece of bread in the cupboard was covered with it, and no dog would touch it. The infectious odour had been communicated to other apartments. The Annual Regiſter ſtates, that the Counteſs of Ceſena was accuſtomed to bathe all her body in camphorated ſpirit of wine. Bianchini cauſed the details of this deplorable event to be publiſhed at the time when it took place, and no one con-

tradicted

tradicted them. It was attested also by Scipio Maffei, a learned cotemporary of Bianchini, who was far from being credulous; and, in the last place, this surprising fact was confirmed to the Royal Society of London by Paul Rolli. The Annual Register mentions also two other facts of the same kind which occurred in England, one at Southampton and the other at Coventry.

An instance of the like kind is preserved in the same work * in a letter of Mr. Wilmer, surgeon:—" Mary Clues, aged 50, was much addicted to intoxication. Her propensity to this vice had increased after the death of her husband, which happened a year and a half before. For about a year, scarcely a day had passed in the course of which she did not drink at least half a pint of rum or aniseed-water. Her health gradually declined, and about the beginning of February she was attacked by the jaundice and confined to her bed. Though she was incapable of much action, and not in a condition to work, she still continued her old habit of drinking every day and smoking a pipe of tobacco. The bed in which she lay stood parallel to the chimney of the apartment, and at the distance from it of about three feet. On Saturday morning, the 1st of March, she fell on the floor; and her extreme weakness having prevented her from getting up, she remained in that state till some one entered and put her to bed. The following night she wished to be left alone. A woman quitted her at half after eleven, and, according to custom, shut the door and locked it. She had put on the fire two large pieces of coal, and placed a light in a candlestick on a chair at the head of her bed. At half after five in the morning a smoke was seen issuing through the window, and the door being speedily broke open, some flames which were in the room were soon extinguished. Between the bed and the chimney were found the remains of the unfortunate Clues: one leg and a thigh were still entire; but there remained nothing of the skin, the muscles, and the viscera. The bones of the cranium, the breast, the spine, and the upper extremities, were entirely calcined, and covered with a whitish efflorescence. The people were much

* Annual Register for 1773, p. 78.

surprised

ſurpriſed that the furniture had ſuſtained ſo little injury. The ſide of the bed which was next to the chimney had ſuffered the moſt; the wood of it was ſlightly burnt; but the feather-bed, the clothes, and covering, were ſafe. I entered the apartment about two hours after it had been opened, and obſerved that the walls and every thing in it were blackened; that it was filled with a very diſagreeable vapour; but that nothing except the body exhibited any ſtrong traces of fire."

This inſtance has great ſimilarity to that related by Vicq-d'Azyr in the *Encyclopédie Methodique*, under the head, Pathologic Anatomy of Man. A woman, about fifty years of age, who indulged to exceſs in ſpirituous liquors, and got drunk every day before ſhe went to bed, was found entirely burnt, and reduced to aſhes. Some of the oſſeous parts only were left, but the furniture of the apartment had ſuffered very little damage. Vicq-d'Azyr, inſtead of diſbelieving this phenomenon, adds, that there have been many other inſtances of the like kind.

We find alſo a circumſtance of this kind in a work entitled, *Acta Medica et philoſophica Hafnienſia*; and in the work of Henry Bohanſer, entitled, *Le nouveau phoſphore enflammé*. A woman at Paris, who had been accuſtomed, for three years, to drink ſpirit of wine to ſuch a degree that ſhe uſed no other liquor, was one day found entirely reduced to aſhes, except the ſkull and extremities of the fingers.

The Tranſactions of the Royal Society of London preſent alſo an inſtance of human combuſtion no leſs extraordinary: It was mentioned at the time it happened in all the journals; it was then atteſted by a great number of eye-witneſſes, and became the ſubject of many learned diſcuſſions. Three accounts of this event, by different authors, all nearly coincide. The fact is related as follows:—" Grace Pitt, the wife of a fiſhmonger of the pariſh of St. Clement, Ipſwich, aged about ſixty, had contracted a habit, which ſhe continued for ſeveral years, of coming down every night from her bed-room, half dreſſed, to ſmoke a pipe. On the night of the 9th of April 1744, ſhe got up from bed as uſual. Her daughter, who ſlept with her, did not perceive ſhe was abſent till next morning when ſhe awoke, ſoon after which ſhe put on her clothes,

clothes, and going down to the kitchen, found her mother ſtretched out on the right ſide, with her head near the grate; the body extended on the hearth, with the legs on the floor, which was of deal, having the appearance of a log of wood, conſumed by a fire without apparent flame. On beholding this ſpectacle, the girl ran in great haſte and poured over her mother's body ſome water contained in two large veſſels in order to extinguiſh the fire; while the fœtid odour and ſmoke which exhaled from the body almoſt ſuffocated ſome of the neighbours who had haſtened to the girl's aſſiſtance. The trunk was in ſome meaſure incinerated, and reſembled a heap of coals covered with white aſhes. The head, the arms, the legs, and the thighs, had alſo participated in the burning. This woman, it is ſaid, had drunk a large quantity of ſpirituous liquor in conſequence of being overjoyed to hear that one of her daughters had returned from Gibraltar. There was no fire in the grate, and the candle had burnt entirely out in the ſocket of the candleſtick, which was cloſe to her. Beſides, there were found near the conſumed body the clothes of a child and a paper ſcreen, which had ſuſtained no injury by the fire. The dreſs of this woman conſiſted of a cotton gown.

Le Cat, in a memoir on ſpontaneous burning, mentions ſeveral other inſtances of combuſtion of the human body. "Having," ſays he, "ſpent ſeveral months at Rheims in the years 1724 and 1725, I lodged at the houſe of Sieur Millet, whoſe wife got intoxicated every day. The domeſtic economy of the family was managed by a pretty young girl, which I muſt not omit to remark, in order that all the circumſtances which accompanied the fact I am about to relate, may be better underſtood. This woman was found conſumed on the 20th of February 1725, at the diſtance of a foot and a half from the hearth in her kitchen. A part of the head only, with a portion of the lower extremities and a few of the vertebræ, had eſcaped combuſtion. A foot and a half of the flooring under the body had been conſumed, but a kneading-trough and a powdering-tub, which were very near the body, had ſuſtained no injury. M. Chretien, a ſurgeon, examined the remains of the body with every juridical

juridical formality. Jean Millet, the husband, being interrogated by the judges who instituted an inquiry into the affair, declared, that about eight in the evening on the 19th of February he had retired to rest with his wife, who not being able to sleep, had gone into the kitchen, where he thought she was warming herself; that, having fallen asleep, he was wakened about two o'clock by an infectious odour, and that, having run to the kitchen, he found the remains of his wife in the state described in the report of the physicians and surgeons. The judges having no suspicion of the real cause of this event, prosecuted the affair with the utmost diligence. It was very unfortunate for Millet that he had a handsome servant-maid, for neither his probity nor innocence was able to save him from the suspicion of having got rid of his wife by a concerted plot, and of having arranged the rest of the circumstance in such a manner as to give it the appearance of an accident. He experienced, therefore, the whole severity of the law; and though, by an appeal to a superior and very enlightened court, which discovered the cause of the combustion, he came off victorious, he suffered so much from uneasiness of mind, that he was obliged to pass the remainder of his melancholy days in an hospital."

Le Cat relates another instance, which has a most perfect resemblance to the preceding:—" M. Boinneau, curé of Plerguer, near Dol," says he, " wrote to me the following letter, dated February 22, 1749: Allow me to communicate to you a fact which took place here about a fortnight ago. Madame de Boiseon, 80 years of age, exceedingly meagre, who had drunk nothing but spirits for several years, was sitting in her elbow-chair before the fire while her waiting-maid went out of the room for a few moments. On her return, seeing her mistress on fire, she immediately gave an alarm, and some people having come to her assistance, one of them endeavoured to extinguish the flames with his hand, but they adhered to it as if it had been dipped in brandy or oil on fire. Water was brought and thrown on the lady in abundance, yet the fire appeared more violent, and was not extinguished till the whole flesh had been consumed. Her skeleton, exceedingly black, remained entire in the chair,

which was only a little ſcorched; one leg only, and the two hands, detached themſelves from the reſt of the bones. It is not known whether her clothes had caught fire by approaching the grate. The lady was in the ſame place in which ſhe ſat every day; there was no extraordinary fire, and ſhe had not fallen. What makes me ſuſpect that the uſe of ſpirits might have produced this effect is, that I have been aſſured, that at the gate of Dinan an accident of the like kind happened to another woman under ſimilar circumſtances."

To theſe inſtances, which I have multiplied to ſtrengthen the evidence, I ſhall add two other facts, of the ſame kind, publiſhed in the *Journal de Medicine**. The firſt took place at Aix, in Provence, and is thus related by Muraire, a ſurgeon:—"In the month of February 1779, Mary Jauffret, widow of Nicholas Gravier, ſhoemaker, of a ſmall ſize, exceedingly corpulent, and addicted to drinking, having been burnt in her apartment, M. Rocas, my colleague, who was commiſſioned to make a report reſpecting the remains of her body, found only a maſs of aſhes, and a few bones, calcined in ſuch a manner that on the leaſt preſſure they were reduced to duſt. The bones of the cranium, one hand, and a foot, had in part eſcaped the action of the fire. Near theſe remains ſtood a table untouched, and under the table a ſmall wooden ſtove, the grating of which, having been long burnt, afforded an aperture, through which, it is probable, the fire that occaſioned the melancholy accident had been communicated: one chair, which ſtood too near the flames, had the ſeat and fore-feet burnt. In other reſpects, there was no appearance of fire either in the chimney or the apartment; ſo that, except the fore-part of the chair, it appears to me that no other combuſtible matter contributed to this ſpeedy incineration, which was effected in the ſpace of ſeven or eight hours."

The other inſtance, mentioned in the *Journal de Medicine* †, took place at Caen, and is thus related by Merille, a ſurgeon of that city, ſtill alive:—"Being requeſted, on the 3d of June 1782, by the king's officers, to draw up a report of the ſtate in which I found Mademoiſelle Thuars, who

* Vol. LIX. p. 440. † Vol. LIX. p. 140.

was

was ſaid to have been burnt, I made the following obſervations:—The body lay with the crown of the head reſting againſt one of the andirons, at the diſtance of eighteen inches from the fire; the remainder of the body was placed obliquely before the chimney, the whole being nothing but a maſs of aſhes. Even the moſt ſolid bones had loſt their form and conſiſtence; none of them could be diſtinguiſhed except the coronal, the two parietal bones, the two lombar vertebræ, a portion of the tibia, and a part of the omoplate; and theſe, even, were ſo calcined, that they became duſt by the leaſt preſſure. The right foot was found entire, and ſcorched at its upper junction; the left was more burnt. The day had been cold, but there was nothing in the grate except two or three bits of wood, about an inch in diameter, burnt in the middle. None of the furniture in the apartment was damaged. The chair on which Mademoiſelle Thuars had been ſitting, was found at the diſtance of a foot from her, and abſolutely untouched. I muſt here obſerve, that this lady was exceedingly corpulent; that ſhe was above ſixty years of age, and much addicted to ſpirituous liquors; that the day even of her death ſhe had drunk three bottles of wine and about a bottle of brandy; and that the conſumption of the body had taken place in leſs than ſeven hours, though, according to appearance, nothing around the body was burnt but the clothes."

The town of Caen affords ſeveral other inſtances of the ſame kind. I have been told by many people, and particularly a phyſician of Argentan, named Bouffet, author of an Eſſay on Intermittent Fevers, that a woman of the lower claſs, who lived at *Place Villars*, and who was known to be much addicted to ſtrong liquor, had been found in her houſe burnt. The extremities of her body only were ſpared, but the furniture was very little damaged.

A like unfortunate accident happened alſo at Caen to another old woman addicted to drinking. I was aſſured by thoſe who told me the fact, that the flames which proceeded from the body could not be extinguiſhed by water; but I think it needleſs to relate the particulars of this and of another ſimilar event which took place in the ſame town, be-

cauſe, as they were not atteſted by a *proces-verbal*, and not having been communicated by profeſſional men, they do not inſpire the ſame confidence.

This collection of inſtances is ſupported, therefore, by all thoſe authentic proofs which can be required to form human teſtimony; for, while we admit the prudent doubt of Deſcartes, we ought to reject the univerſal doubt of the Pyrrhoniſts. The multiplicity and uniformity even of theſe facts, which occurred in different places, and were atteſted by ſo many enlightened men, carry with them conviction; they have ſuch a relation to each other that we are inclined to aſcribe them to the ſame cauſe.

1. The perſons who experienced the effects of this combuſtion had for a long time made an immoderate uſe of ſpirituous liquors.

2. The combuſtion took place only in women.

3. Theſe women were far advanced in life.

4. Their bodies did not take fire ſpontaneouſly, but were burnt by accident.

5. The extremities, ſuch as the feet and the hands, were generally ſpared by the fire.

6. Water ſometimes, inſtead of extinguiſhing the flames which proceeded from the parts on fire, gave them more activity.

7. The fire did very little damage, and often even ſpared the combuſtible objects which were in contact with the human body at the moment when it was burning.

8. The combuſtion of theſe bodies left as a reſiduum fat fœtid aſhes, with an unctuous, ſtinking, and very penetrating ſoot.

Let us now enter into an examination of theſe eight general obſervations.

The firſt idea which occurs on reading the numerous inſtances of human combuſtion above related is, that thoſe who fell victims to thoſe fatal accidents were almoſt all addicted to ſpirituous liquors. The woman mentioned in the Tranſactions of Copenhagen had for three years made ſuch an immoderate uſe of them that ſhe would take no other nouriſhment. Mary Clues, for a year before the accident happened, had ſcarcely been a ſingle day without drinking half a pint of

of rum or of aniseed-water. The wife of Millet had been continually intoxicated; Madam de Boiseon for several years had drunk nothing but spirits; Mary Jauffret was much addicted to drinking; and Mademoiselle Thuars, and the other women of Caen, were equally fond of strong liquors.

Such excess, in regard to the use of spirituous liquors, must have had a powerful action on the bodies of the persons to whom I allude. All their fluids and solids must have experienced its fatal influence; for the property of the absorbing vessels, which is so active in the human body, seems on this occasion to have acted a distinguished part. It has been observed that the urine of great drinkers is generally aqueous and limpid. It appears, that in drunkards who make an immoderate use of spirituous liquors, the aqueous part of their drink is discharged by the urinary passage, while the alcoholic, almost like the volatile part of aromatic substances, not being subjected to an entire decomposition, is absorbed into every part of their bodies.

I shall now proceed to the second general observation, that the combustion took place only in women.

I will not pretend to assert that men are not liable to combustion in the same manner, but I have never yet been able to find one well certified instance of such an event; and as we cannot proceed with any certainty but on the authority of facts, I think this singularity so surprising as to give rise to a few reflections. Perhaps when the cause is examined, it will appear perfectly natural. The female body is in general more delicate than that of the other sex. The system of their solids is more relaxed; their fibres are more fragile and of a weaker structure, and therefore their texture more easily hurt. Their mode of life also contributes to increase the weakness of their organization. Women, abandoned in general to a sedentary life, charged with the care of the internal domestic economy, and often shut up in close apartments, where they are condemned to spend whole days without taking any exercise, are more subject than men to become corpulent. The texture of the soft parts in female bodies being more spongy, absorption ought to be freer; and as their whole

whole bodies imbibe ſpirituous liquors with more eaſe, they ought to experience more readily the impreſſion of fire. Hence that combuſtion, the melancholy inſtances of which ſeem to be furniſhed by women alone; and it is owing merely to the want of a certain concurrence of circumſtances and of phyſical cauſes, that theſe events, though leſs rare than is ſuppoſed, do not become more common.

The ſecond general obſervation ſerves to explain the third; I mean, that the combuſtion took place only in women far advanced in life. The Counteſs of Ceſena was ſixty-two years of age; Mary Clues, fifty-two; Grace Pitt, ſixty; Madame de Boiſeon, eighty; and Mademoiſelle Thuars more than ſixty. Theſe examples prove that combuſtion is more frequent among old women. Young perſons, diſtracted by other paſſions, are not much addicted to drinking; but when love, departing along with youth, leaves a vacuum in the mind, if its place be not ſupplied by ambition or intereſt, a taſte for gaming, or religious fervor, it generally falls a prey to intoxication. This paſſion ſtill increaſes as the others diminiſh, eſpecially in women, who can indulge it without reſtraint. Wilmer, therefore, obſerves, "that the propenſity of Mary Clues to this vice had always increaſed after the death of her huſband, which happened about a year before:" almoſt all the other women of whom I have ſpoken, being equally unconfined in regard to their actions, could gratify their attachment to ſpirituous liquors without oppoſition.

It may have been obſerved that the obeſity of women, as they advance in life, renders them more ſedentary; and if, as has been remarked by Baumes *, a ſedentary life over-charges the body with hydrogen, this effect muſt be ſtill more ſenſible among old women. Dancing and walking, which form ſalutary recreation for young perſons, are at a certain age interdicted as much by nature as by prejudice. It needs therefore excite no aſtoniſhment that old women, who are in general more corpulent and more addicted to drinking, and who are often motionleſs like inanimate

* Eſſai du Syſtême Chemique de la Science de l'Homme.

maſſes,

maſſes, during the moment of intoxication, ſhould experience the effects of combuſtion.

Perhaps we have no occaſion to go very far to ſearch for the cauſe of theſe combuſtions. The fire of the wooden ſtove, the chimney, or of the candle, might have been communicated to the clothes, and might have in this manner burnt the perſons above mentioned, on account of the peculiar diſpoſition of their bodies. Maffei obſerves that the Counteſs of Ceſena was accuſtomed to bathe her whole body with ſpirit of wine. The vicinity of the candle and lamp, which were found near the remains of her body, occaſioned, without doubt, the combuſtion. This accident reminds us of that which happened to Charles II. king of Navarre. This prince, being addicted to drunkenneſs and exceſſes of every kind, had cauſed himſelf to be wrapped up in cloths dipped in ſpirits, in order to revive the natural heat of his body which had been weakened by debauchery; but the cloths caught fire while his attendants were faſtening them, and he periſhed a victim to his imprudence.

Beſides accidental combuſtion, it remains for us to examine whether ſpontaneous combuſtion of the human body can take place, as aſſerted by Le Cat. Spontaneous combuſtion is the burning of the human body without the contact of any ſubſtance in a ſtate of ignition. Nature, indeed, affords ſeveral inſtances of ſpontaneous combuſtion in the mineral and vegetable kingdoms. The decompoſition of pyrites, and the ſubterranean proceſſes which are carried on in volcanoes, afford proofs of it. Coal-mines may readily take fire ſpontaneouſly; and this has been found to be the caſe with heaps of coals depoſited in cloſe places. It is by a fermentation of this kind that dunghills ſometimes become hot, and take fire. This may ſerve alſo to explain why truſſes of hay, carried home during moiſt weather, and piled up on each other, ſometimes take fire. But, can ſpontaneous combuſtion take place in the human body? If ſome authors are to be credited *, very violent combuſtion may be produced in our bodies by nature and by artificial proceſſes. Sturmius † ſays that in the northern countries flames often burſt from

* German Ephemerides, Obſerv. 77. † Ibid. Tenth year, p. 55.

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the ſtomach of perſons in a ſtate of intoxication. Three noblemen of Courland having laid a bet which of them could drink moſt ſpirits, two of them died in conſequence of ſuffocation by the flames which iſſued with great violence from their ſtomachs. We are told by Thomas Bartholin *, on the authority of Vorſtius, that a ſoldier, who had drunk two glaſſes of ſpirits, died after an eruption of flames from his mouth. In his third century Bartholin mentions another accident of the ſame kind after a drinking-match of ſtrong liquor.

It now remains to decide, from theſe inſtances, reſpecting the accidental or ſpontaneous cauſes which produce combuſtion. Nature, by aſſuming a thouſand different forms, ſeems at firſt as if deſirous to elude our obſervation; but, on mature reflection, if it be found eaſy to prove accidental combuſtion, ſpontaneous combuſtion appears altogether improbable; for, even admitting the inſtances of people ſuffocated by flames which iſſued from their mouths, this is ſtill far from the combuſtion of the whole body. There is a great difference between this ſemi-combuſtion and ſpontaneous combuſtion ſo complete as to reduce the body to aſhes, as in the caſes above mentioned. As the human body has never been ſeen to experience total combuſtion, theſe aſſertions ſeem rather the productions of a fervid imagination than of real obſervation; and it too often happens that Nature in her mode of action does not adopt our manner of ſeeing.

I ſhall not extend further theſe obſervations on the combuſtion of the human body, as I flatter myſelf that after this examination every perſon muſt be ſtruck with the relation which exiſts between the cauſe of this phenomenon and the effects that enſue. A ſyſtem embelliſhed with imaginary charms is often ſeducing, but it never preſents a perfect whole. We have ſeen facts juſtify reaſoning, and reaſoning ſerve afterwards to explain facts. The combuſtion of the human body, which on the firſt view appears to have in it ſomething of the marvellous, when explained, exhibits nothing but the utmoſt ſimplicity: ſo true it is, that the wonderful is often produced by effects which, as they rarely ſtrike

* Firſt century.

our

our eyes, permit our minds ſo much the leſs to diſcover their real cauſe.

Some people, however, may aſcribe to the wickedneſs of mankind what we aſcribe to accident. It may be ſaid, that aſſaſſins, after putting to death their unfortunate victims, rubbed over their bodies with combuſtible ſubſtances, by which they were conſumed. But even if ſuch an idea ſhould ever be conceived, it would be impoſſible to carry it into execution. Formerly, when criminals were condemned to the flames, what a quantity of combuſtible ſubſtances was neceſſary to burn their bodies! A baker's boy, named Renaud, being condemned to be burnt a few years ago at Caen, two large cart-loads of faggots were required to conſume the body, and at the end of more than ten hours ſome remains of the bones were ſtill to be ſeen. What proves that the combuſtion in the before-mentioned inſtances was not artificial is, that people often arrived at the moment when it had taken place, and that the body was found in its natural ſtate. People entered the houſe of Madame Boiſeon at the time when her body was on fire, and all the neighbours ſaw it. Beſides, the people of whom I have ſpoken were almoſt all of the loweſt claſs, and not much calculated to give riſe to the commiſſion of ſuch a crime. The woman mentioned in the Tranſactions of Copenhagen was of the pooreſt condition; Grace Pitt was the wife of a fiſhmonger; Mary Jauffret that of a ſhoemaker; and two other women, who reſided at Caen, belonged to the loweſt order of ſociety. It is inconteſtible, then, that in the inſtances I have adduced the combuſtion was always accidental and never intentional.

It may be ſeen that a knowledge of the cauſes of this phenomenon is no leſs intereſting to criminal juſtice than to natural hiſtory, for unjuſt ſuſpicions may ſometimes fall on an innocent man. Who will not ſhudder on recollecting the caſe of the unfortunate inhabitant of Rheims, who, after having loſt his wife by the effect of combuſtion, was in danger of periſhing himſelf on the ſcaffold, condemned unjuſtly by an ignorant tribunal!

I ſhall conſider myſelf happy if this picture of the fatal effects of intoxication makes an impreſſion on thoſe addicted

to this vice, and particularly on women, who moſt frequently become the victims of it. Perhaps the frightful details of ſo horrid an evil as that of combuſtion will reclaim drunkards from this horrid practice. Plutarch relates, that at Sparta children were deterred from drunkenneſs by exhibiting to them the ſpectacle of intoxicated ſlaves, who, by their hideous contorſions, filled the minds of theſe young ſpectators with ſo much contempt that they never afterwards got drunk. This ſtate of drunkenneſs, however, was only tranſitory. How much more horrid it appears in thoſe unfortunate victims conſumed by the flames and reduced to aſhes! May men never forget that the vine ſometimes produces very bitter fruit—diſeaſe, pain, repentance, and death!

VIII. *Meteorological Axioms, by* L. COTTE; *or the general Reſult of his own and foreign Meteorological Obſervations during the courſe of Thirty Years* *.

OUR meteorological obſervations are as old as the eſtabliſhment of the Academy of Sciences in the year 1666, and have never yet been interrupted. The moſt celebrated academicians, ſuch as a Sidileau, a de la Hire, a Maraldi, a Caſſini, a Fouchy, a Chappe, &c. have contributed towards them; and ſeveral members, ſuch as Morin, Duhamel, Malovin, Meſſier, &c. paid attention to the ſame object without making themſelves much known. The correſpondents of the Academy alſo frequently communicated to it their meteorological obſervations. All the learned ſocieties in Europe comprehend meteorology in the liſt of their labours, and particularly the Royal Society of London, the Academies of Berlin, Stockholm, Peterſburg, &c. but, above all, the Medical Societies at Paris and the Hague, and the Meteorologic Society at Manheim. Theſe three learned bodies have therefore the moſt extenſive correſpondence.

I have communicated to the public the reſult of the obſervations made by all theſe ſocieties as well as of my own during

* From *Neues Journal der Phyſik*, by Profeſſor Gren, Vol. III, part 5.

during the courſe of thirty years, partly in my Treatiſe and Memoirs on Meteorology, and partly in the Hiſtory of the Medical Society, the Collection des Savans etrangers, the Journaux des Savans, de Phyſique, de France, &c. I endeavoured to neglect nothing that had any relation to meteorology, and I flatter myſelf that I have given the reſult of every thing that has been publiſhed for a hundred years on this branch of ſcience. But how tedious is its progreſs! From this aſtoniſhing collection of obſervations I have as yet been able to deduce only a very ſmall number of phyſical truths, which I here lay before the public under the title of Meteorological Axioms. They are not drawn from the whole maſs of the before-mentioned obſervations, made for a very long period, and in a careleſs manner, and with very imperfect inſtruments, but from thoſe of the laſt thirty or forty years. They are as follow:—

I.

Of the Barometer.

1. The greateſt changes of the barometer commonly take place, during clear weather, with a north wind; and the ſmall riſings during cloudy, rainy, or windy weather, with a ſouth, or nearly ſouth, wind.

2. The ſtate of the mercury changes more in the winter than the ſummer months; ſo that its greateſt riſing and falling take place in winter; but its mean elevation is greater in ſummer than in winter.

3. The changes of the ſtate of the barometer are nearly null at the equator, and become greater the more one removes from it towards the poles.

4. They are more conſiderable in valleys than on mountains.

5. The more variable the wind, the more changeable the ſtate of the barometer.

6. It is lower at midnight and noon than at other periods of the day: its greateſt daily height is towards evening.

7. Between ten at night and two in the morning, and alſo in the day, the riſing and falling of the mercury are leſs: the contrary is the caſe between ſix and ten in the morning and evening.

8. Between two and ſix in the morning and evening it riſes as often as it falls; but in ſuch a manner that it oftener riſes about that time in the winter months, and falls oftener in the ſummer months.

9. The oſcillations are leſs in ſummer, greater in winter, and very great at the equinoxes.

10. They are greater alſo in the day-time than during the night.

11. The higher the ſun riſes above the horizon, the leſs are the oſcillations; they increaſe as he approaches the weſtern ſide of the horizon, and are exceedingly great when he comes oppoſite to the eaſtern part of the horizon.

12. They are, to a certain degree, independent of the changes of temperature.

13. The mercury generally riſes between the new and the full moon, and falls between the latter and the new moon.

14. It riſes more in the apogeum than the perigeum: it uſually riſes between the northern luniſtice and the ſouthern, and falls between the ſouthern luniſtice and the northern.

15. In general, a compariſon of the variations of the mercury with the poſitions of the moon gives nothing certain: the reſults of Nos. 13 and 14 are the moſt conſtant.

16. In our neighbourhood the barometer never continues twenty-four hours without changing.

17. The barometers in the weſtern diſtricts riſe or fall ſooner than thoſe in the more eaſtern.

18. When the ſun paſſes the meridian the mercury if falling continues to fall, and its fall is often haſtened.

19. When the mercury at the ſame period is riſing, it falls, remains ſtationary, or riſes more ſlowly.

20. When the mercury, under the ſame circumſtances, is ſtationary, it falls; unleſs, before or after it becomes ſtationary, it has been in the act of riſing.

21. The above changes commonly take place between eleven in the morning and one in the afternoon, but oftener before than after noon.

22. Before high tides there is almoſt always a great fall of the mercury; this takes place oftener at the full than the new moon.

II.

II.

Of the Thermometer.

1. The extreme degrees of heat are almoſt every where the ſame: this, however, is not the caſe in regard to the extreme degrees of cold.

2. The thermometer riſes to its extreme height oftener in the temperate zones than in the torrid zone.

3. It changes very little between the tropics; its variations, like thoſe of the barometer, are greater the more one proceeds from the equator towards the poles.

4. It riſes higher in the plains than on mountains.

5. It does not fall ſo much in the neighbourhood of the ſea as in inland parts.

6. The wind has no influence on its motions.

7. Moiſture has a peculiar influence on it, if followed by a wind which diſperſes it.

8. The greateſt heat, and the greateſt cold, take place about ſix weeks after the northern or ſouthern ſolſtice.

9. The thermometer changes more in ſummer than in winter.

10. The coldeſt period of the day is before ſun-riſe.

11. The greateſt heat in the ſun and the ſhade ſeldom takes place on the ſame day.

12. The heat decreaſes with far more rapidity from September and October, than it increaſed from July to September.

13. It is not true, that a very cold winter is the prognoſtic of a very hot ſummer.

III.

Of the Wind.

1. The winds between the tropics are regular and periodical.

2. The more one removes from the tropics, the more changeable they are found.

3. The winds are more changeable in winter than in ſummer, and towards the equinoxes than at any other time.

4. It is not true, that the wind which blows about the time

time of the equinoxes will be the prevailing wind during the next ſix months.

5. A freſh breeze always ſprings up before ſun-riſe, eſpecially in ſummer.

6. In the neighbourhood of the ſea there is a periodical land and a ſea breeze.

7. Violent winds are more prevalent in the neighbourhood of mountains than in the open plains.

IV.

Of Rain and Evaporation.

1. Rain is more frequent in winter than in ſummer, but more abundant in ſummer than in winter.

2. It is alſo more abundant, but leſs common, in ſouthern countries, than in thoſe where the temperature is cold and moderate.

3. The increaſe and decreaſe of rivers are not always in proportion to the quantity of the rain which falls.

4. The quantity of rain is greater in low than in high diſtricts, and ſtill more ſo in the neighbourhood of foreſts and mountains.

5. The quantity of evaporation generally exceeds that of the rain.

6. The greater the heat, the ſtronger the evaporation.

7. It is greater alſo while the wind blows from the northern regions, than when it comes from the ſouthern.

8. In the laſt place, it is greater during dry and cold, than during moiſt and warm, weather.

9. The greateſt drought indicated by the hygrometer takes place in April.

V.

Atmoſpheric Electricity.

1. Electricity manifeſts itſelf oftener without ſtorms than with them.

2. It is occaſioned more frequently by dry than by rainy clouds.

3. It is oftener poſitive than negative, particularly when occaſioned by ſtationary clouds, becauſe theſe, without doubt, are

are at ſuch a great diſtance, that the electricity which riſes from the earth cannot reach them: in the oppoſite caſe it is exceedingly variable.

4. The atmoſphere exhibits ſigns of electricity at all times; at every hour of the day and the night.

VI.

The Magnetic Needle.

1. The greateſt declination of the needle from the north towards the weſt takes place about two in the afternoon, and the greateſt approximation of it towards the north, about eight in the morning; ſo that, from the laſt-mentioned hour till about two in the afternoon, it endeavours to remove from the north, and between two in the afternoon and the next morning to approach it.

2. The annual progreſs of the magnetic needle is as follows:—Between January and March it removes from the north; between March and May it approaches it; in June it is ſtationary; in July it removes from it; in Auguſt, September, and October, it approaches it; its declination in October is the ſame as in May; in November and December it removes from the north: its greateſt weſtern declination is at the vernal equinox, and its greateſt approximation to the north at the autumnal equinox.

3. The declination of the magnetic needle is different according to the latitude: among us it has always increaſed ſince 1666: before that period it was eaſterly.

4. Before volcanic eruptions and earthquakes, the magnetic needle is often ſubject to very extraordinary movements.

5. The magnetic needle is agitated before and after the appearance of the northern lights: its declination on theſe occaſions is about noon greater than uſual.

6. The greater or leſs appearance of theſe northern lights is variable: ſome years this phenomenon is very frequent, in others uncommon. For two or three years they have occurred very ſeldom.

7. The northern lights are more frequent about the time of the equinoxes than at other periods of the year.

8. This phenomenon is almoſt conſtant during the long winter in the polar regions, and is the more uncommon the nearer the equator.

9. Southern lights have been obſerved alſo in the regions near the ſouth pole.

10. The northern lights are often accompanied with lightning, and a noiſe like that of electricity; while the lightning proceeds partly from the middle of the northern lights, and partly from the neighbouring clouds.

VII.

The Lunar Period of Nineteen Years.

It appears that the general temperature of a year returns every nineteen years; an epoch when the phaſes and poſitions of the moon in regard to the earth are again the ſame.

I might add more reſults, but I ſhall confine myſelf to thoſe found moſt conſtant by obſervation, and conclude with wiſhing, that the zeal of obſervers may contribute to confirm more and more the certainty of theſe Axioms, or to diſcover new ones.

IX. *On the Decompoſition of Azotic into Hydrogen and Oxygen Gas, by M.* Girtanner, *and on the radical of the Muriatic Acid. A Letter from Van Mons, of Bruſſels, to Delamtherie* *.

I TAKE the earlieſt opportunity of informing you, that Girtanner has decompoſed azot, and reduced it to hydrogen and oxygen, in the proportion of 0·93 of the former and 0·07 of the latter. From this it ſeems to follow, that azot, ammonia, water, atmoſpheric air, &c. are compounds of theſe two principles in varied proportions. In analyſing air we do not ſeparate but compound the azotic gas by ſubtracting a part of oxygen from the hydro-oxygen fluid, which conſtitutes that air. This is, perhaps, the reaſon why combuſtion is more lively in pure oxygen gas, or oxygen gas not

* From *Journal de Phyſique*, an. 8.

engaged

engaged in a combination with hydrogen. Argil is the ſubſtance which beſt decompoſes atmoſpheric air, and ſo compounds azot; and this agrees pretty well with the experiments of Humboldt. This property of argil explains the neceſſity of its preſence in artificial nitre-beds, and gives us reaſon to think that Wiegleb and Wurzer are not altogether deceived when they think of converting aqueous vapour into azotic gas. You muſt have remarked in my experiments on this converſion, that I could not account properly for the large quantity of gas which I frequently happened to collect.

Stormy rains may be means employed by Nature to free atmoſpheric air from that exceſs of oxygen continually flowing into it from plants, by combining into water a part of the two gaſes of which it is compoſed. This much is certain, that the uniform mixture of two fluids of denſities ſo different as thoſe of azotic and oxygen gas, has always led me to ſuſpect an union of theſe two gaſes.

In a word, if the diſcovery of Girtanner ſhall be confirmed it will enable us to account for the almoſt total diſappearance of azot during the decompoſition of nitre by fire.

M. Girtanner perſiſts in maintaining, that hydrogen is the radical of the muriatic acid, but this hydrogenic acid contains leſs oxygen than water. The experiments which I oppoſed to my friend * all tend either to oxygenate that liquid or to de-oxygenate the acid. I followed an oppoſite courſe to Girtanner, but which was pointed out to me by himſelf, who at that time conſidered the muriatic acid as oxygenated water.

Trommſdorff was not wrong when he informed me †, that there would perhaps be more hope of diſcovering the radicals of undecompoſed acids, by endeavouring rather to oxygenate than to de-oxygenate theſe ſubſtances.

I am not yet acquainted with the experiments of M. Girtanner, but I have already made a mixture of hydrogen gas and oxygen gas, in the proportion mentioned, without obtaining azotic gas. J. B. VAN MONS.

* Mémoires de l'Inſtitut National, Vol I. p. 36 and 44.

† *Annales de Chimie*, Vol. XXXII.

X. *A Botanical Defcription of Urceola Elaftica, or Caout-chouc Vine of Sumatra and Pullo-pinang; with an Account of the Properties of its infpiffated Juice, compared with thofe of the American Caout-chouc.* By William Roxburgh, M. D.*

FOR the difcovery of this ufeful vine, we are, I believe, indebted to Mr. Howifon, late furgeon at Pullo-pinang; but it would appear he had no opportunity of determining its botanical character. To Doctor Charles Campbell, of Fort Marlborough, we owe the gratification arifing from a knowledge thereof.

About twelve months ago I received from that gentleman, by means of Mr. Fleming, very complete fpecimens, in full foliage, flower, and fruit. From thefe I was enabled to reduce it to its clafs and order in the Linnæan fyftem. It forms a new genus in the clafs *Pentandria*, and order *Monogynia*, and comes in immediately after *Tabernæmontana*, confequently belongs to the thirtieth natural order, or clafs called *Contortæ* by Linnæus in his natural method of claffification or arrangement. One of the qualities of the plants of this order is, their yielding, on being cut, a juice which is generally milky, and for the moft part deemed of a poifonous nature.

The generic name *Urceola*, which I have given to this plant, is from the ftructure of the corol, and the fpecific name from the quality of its thickened juice.

So far as I can find, it does not appear that ever this vine has been taken notice of by any European till now. I have carefully looked over the *Hortus Malabaricus*, Rumphius's *Herbarium Amboinenfe*, &c. &c. figures of Indian plants, without being able to find any one that can with any degree of certainty be referred to. A fubftance of the fame nature, and probably the very fame, was difcovered in the ifland of Mauritius by M. Poivre, and from thence fent to France; but, fo far as I know, we are ftill ignorant of the plant that yields it.

* From the *Afiatic Refearches*, Vol. V.

The

The impropriety of giving to *Caout-chouc* the term gum, refin, or gum-refin, every one feems fenfible of, as it poffeffes qualities totally different from all fuch fubftances as are ufually arranged under thofe generic names; yet it ftill continues, by moft authors I have met with, to be denominated elaftic refin or elaftic gum. Some term it fimply *Caout-chouc*, which I wifh may be confidered as the generic name of all fuch concrete vegetable juices (mentioned in this memoir) as poffefs elafticity, inflammability, and are foluble in the effential oils, without the affiftance of heat.

In a mere definition it would be improper to ftate what qualities the object does not poffefs; confequently, it muft be underftood that this fubftance is not foluble in the menftruums which ufually diffolve refins and gums.

Eaft-India *Caout-chouc* would be a very proper fpecific name for that of *Urceola elaftica*, were there not other trees which yield juices fo fimilar as to come under the fame generic character; but as this is really the cafe, I will apply the name of the tree which yields it for a fpecific one. E. G. *Caout-chouc* of *Urceola Elaftica*, *Caout-chouc* of *Ficus Indica*, *Caout-chouc* of *Artocarpus integrifolia*, &c. &c.

Defcription of the Plant Urceola.

PENTANDRIA MONOGYNIA.

Gen. Char. Calyx beneath five-toothed; corol one-petaled, pitcher-fhaped, with its contracted mouth five-toothed; nectary entire, furrounding the germs; follicles two, round, drupacious; feeds numerous, immerfed in pulp.

URCEOLA ELASTICA.

Shrubby, twining, leaves oppofite, oblong, panicles terminal; is a native of Sumatra, Pullo-pinang, &c. Malay countries.

Stem, woody, climbing over trees, &c. to a very great extent, young fhoots twining, and a little hairy, bark of the old woody parts thick, dark-coloured, confiderably uneven, a little fcabrous, on which I found feveral fpecies of mofs, particularly large patches of lichen: the wood is white, light, and porous.

Leaves, oppofite, fhort-petioled, horizontal, ovate, oblong,

 pointed,

pointed, entire, a little ſcabrous, with a few ſcattered white hairs on the under-ſide.

Stipules, none.

Panicles, terminal, brachiate, very ramus.

Flowers, numerous, minute, of a dull greeniſh colour, and hairy on the outſide.

Bracts, lanceolate, one at each diviſion and ſubdiviſion of the panicle.

Calyx, perianth, one-leaved, five-toothed, permanent.

Corol, one-petaled, pitcher-ſhaped, hairy, mouth much contracted, five-toothed, diviſions erect, acute, nectary entire, cylindric, embracing the lower two-thirds of the germs.

Stamens, filaments five, very ſhort from the baſe of the corol. Anthers arrow-ſhaped, converging, bearing their pollen in two grooves on the inſide near the apex; between theſe grooves and the inſertions of the filaments they are covered with white ſoft hairs.

Piſtil, germs two; above the nectary they are very hairy round the margins of their truncated tops. Style ſingle, ſhorter than the ſtamens. Stigma ovate, with a circular band, dividing it into two portions of different colours.

Per. Follicles two, round, laterally compreſſed into the ſhape of a turnip, wrinkled, leathery, about three inches in their greateſt diameters; one-celled, two-valved.

Seeds, very numerous, reniform, immerſed in firm fleſhy pulp.

Explanation of the Figures. (Plate IV.)

1. A branchlet in flower, natural ſize.

2. A flower magnified.

3. The ſame laid open, which expoſes to view the ſituation of the ſtamens inſerted into the bottom of the corol, the nectarium ſurrounding the lower half of the two germs, their upper half with hairy margins, the ſtyle and ovate party-coloured; ſtigma appearing above the nectary.

4. Outſide of one of the ſtamens, } much magnified.
5. Inſide of the ſame, }

6. The nectarium laid open, expoſing to view the whole of the piſtil.

7. The two ſeed-veſſels (called by Linnæus *follicles*), natural

tural ſize; half of one of them is removed, to ſhow the ſeed immerſed in pulp. A portion thereof is alſo cut away, which more clearly ſhows the ſituation and ſhape of the ſeed.

From wounds made in the bark of this plant there oozes a milky fluid, which, on expoſure to the open air, ſeparates into an elaſtic coagulum and watery liquid, apparently of no uſe after the ſeparation takes place. This coagulum is not only like the American *Caout-chouc*, or Indian rubber, but poſſeſſes the ſame properties, as will be ſeen from the following experiments and obſervations made on ſome which had been extracted from the vine about five months ago. A ball of it now before me, is, to my ſenſe, totally void of ſmell even when cut into, is very firm, nearly ſpherical, meaſures nine and a half inches in circumference, and weighs ſeven ounces and a quarter; its colour on the outſide is that of American *Caout-chouc* where freſh cut into, of a light-brown colour, till the action of the air darkens it: throughout there are numerous ſmall cells filled with a portion of light-brown watery liquid above mentioned. This ball, in ſimply falling from a height of fifteen feet, rebounds about ten or twelve times; the firſt is from five to ſeven feet high, the ſucceeding ones of courſe leſſening by gradation.

This ſubſtance is not now ſoluble in the above-mentioned liquid contained in its cells, although ſo intimately blended therewith, when firſt drawn from the plant, as to render it ſo thin as to be readily applied to the various purpoſes to which it is ſo well adapted when in a fluid ſtate.

From what has been ſaid, it will be evident that this *Caout-chouc* poſſeſſes a conſiderable ſhare of ſolidity and elaſticity in an eminent degree. I compared the laſt quality with that of American *Caout-chouc*, by taking ſmall ſlips of each, and extending them till they broke; that of Urceola was found capable of bearing a much greater degree of extenſion (and contraction) than the American: however, this may be owing to the time the reſpective ſubſtances have been drawn from their plants.

The Urceola *Caout-chouc* rubs out the marks of a black-lead pencil as readily as the American, and is evidently the ſubſtance of which the Chineſe make their elaſtic rings.

It

It contains much combuftible matter, burning entirely away, with a clear flame, emitting a confiderable deal of dark-coloured fmoke, which readily condenfes into a large proportion of exceeding fine foot, or lamp-black; at the fame time it gives but little fmell, and that not difagreeable: the combuftion is often fo rapid as to caufe drops of a black liquid, very like tar, to fall from the burning mafs; this is equally inflammable with the reft, and continues when cold in its femi-fluid ftate, but totally void of elafticity: in America, the *Caout-chouc* is ufed for torches; ours appears to be equally fit for that purpofe. Expofed in a filver fpoon to a heat about equal to that which melts lead or tin, it is reduced into a thick, black, inflammable liquid, fuch as drops from it during combuftion, and is equally deprived of its elaftic powers, confequently rendered unfit for thofe purpofes for which its original elafticity rendered it fo proper.

It is infoluble in fpirits of wine, nor has water any more effect on it, except when affifted by heat, and then it is only foftened by it.

Sulphuric acid reduced it into a black, brittle, charcoal-like fubftance, beginning at the furface of the *Caout-chouc*, and if the pieces are not very thin or fmall, it requires fome days to penetrate to their centre; during the procefs the acid is rendered very dark-coloured, almoft black. If the fulphuric acid is previoufly diluted with only an equal quantity of water, it does not then appear to have any effect on this fubftance, nor is the colour of the liquid changed thereby.

Nitric acid reduced it in twelve hours to a foft, yellow, unelaftic mafs, while the acid is rendered yellow; at the end of two days, the *Caout-chouc* had acquired fome degree of friability and hardnefs. The fame experiment made on American *Caout-chouc* was attended with fimilar effects. Muriatic acid had no effect on it.

Sulphuric æther only foftened it, and rendered the different minute portions it was cut into eafily united, and without any feeming diminution of elafticity.

Nitric æther I did not find a better menftruum than the vitriolic; confequently, if the æther I employed was pure, of which I have fome doubt, this fubftance muft differ effentially

ſentially from that of America, which Berniard reports to be ſoluble in nitric æther.

Where this ſubſtance can be had in a fluid ſtate, there is no neceſſity for diſſolving or ſoftening it, to render it applicable to the various uſes for which it may be required; but where the dry *Caout-chouc* is only procurable, ſulphuric æther promiſes to be an uſeful medium, by which it may be rendered ſo ſoft as to be readily formed into a variety of ſhapes.

Like American *Caout-chouc*, it is ſoluble in the eſſential oil of turpentine; and I find it equally ſo in Cajeput oil, an eſſential oil, ſaid to be obtained from the leaves of *Melaleuca Leucadendron*. Both ſolutions appear perfect, thick, and very glutinous. Spirits of wine, added to the ſolution in Cajeput oil, ſoon united with the oil, and left the *Caout-chouc* floating on the mixture in a ſoft ſemi-fluid ſtate, which, on being waſhed in the ſame liquor, and expoſed to the air, became as firm as before it was diſſolved, and retained its elaſtic powers perfectly, while in the intermediate ſtates, between ſemi-fluid and firm, it could be drawn out into long tranſparent threads, reſembling, in the poliſh of their ſurface, the fibres of the tendons of animals; when they broke, the elaſticity was ſo great, that each end inſtantaneouſly returned to its reſpective maſs. Through all theſe ſtages, the leaſt preſſure with the finger and thumb united different portions as perfectly as if they never had been ſeparated, and without any clammineſs or ſticking to the fingers, which renders moſt of the ſolutions of *Cacut-chouc* ſo very unfit for the purpoſes for which they are required. A piece of catgut, covered with the half-inſpiſſated ſolution, and rolled between two ſmooth ſurfaces, ſoon acquired a poliſh and conſiſtence very proper for bougies. Cajeput oil I alſo found a good menſtruum for American *Cacut-chouc*, and was as readily ſeparated, by the addition of a little ſpirit of wine or rum, as the other, and appears equally fit for uſe, as I covered a piece of catgut with the waſhed ſolution as perfectly as with that of *Urceola*. The only difference I could obſerve, was a little more adheſiveneſs, from its not drying ſo quickly; the oil of turpentine had greater attraction for the *Caout-chouc* than for the ſpirits of

 wine,

wine, consequently remained obstinately united to the former, which prevented its being brought into that state of firmness fit for handling, which it acquired when Cajeput oil was the menstruum.

The Cajeput solution employed as a varnish did not dry, but remained moist and clammy, whereas the turpentine solution dried pretty fast.

Expressed oil of olives and linseed proved imperfect menstruums while cold, as the *Caout-chouc*, in several days, was only rendered soft, and the oils viscid, but with a degree of heat equal to that which melts tin, continued for about twenty-five minutes, it was perfectly dissolved, but the solution remained thin, and void of elasticity. I also found it soluble in wax and in butter in the same degree of heat; but still these solutions were without elasticity, or any appearance of being useful.

I shall now conclude what I have to offer on the *Caout-chouc*, or *Urceola elastica*, with observing, that some philosophers of eminence have entertained doubts of the American *Caout-chouc* being a simple vegetable substance, and suspect it to be an artificial production; an idea which I hope the above detailed experiments will help to eradicate, and consequently, to restore the histories of that substance by M. De la Condamine and others, to that degree of credit to which they seem justly entitled; in support of which it may be further observed, that, besides *Urceola elastica*, there are many other trees, natives of the torrid zone, that yield a milky juice, possessing qualities nearly of the same nature; as *artocarpus integrifolia* (common-jack tree), *ficus religiosus et Indica*, *Hippomane biglandulosa*, *Cecropia peltata*, &c.

The *Caout-chouc*, or *Ficus religiosa*, the Hindus consider the most tenacious vegetable juice they are acquainted with; from it their best bird-lime is prepared. I have examined its qualities, as well as those of *ficus Indica* and *artocarpus integrifolia*, by experiments similar to those above related, and found them triflingly elastic when compared with the American and Urceola *Caout-choucs*, but infinitely more viscid than either; they are also inflammable, though in a less degree, and show nearly the same phenomena when

immersed

immerſed in the mineral acids, ſolution of cauſtic alkali, alkohol, fat and eſſential oils; but the ſolution in Cajeput oil could not be ſeparated by ſpirits of wine, and collected again, like the ſolutions of the Urceola and American *Caoutchoucs.*

XI. *Account of ſome Improvements introduced by the Scotch Diſtillers, which enable them to charge and run off the ſame Still upwards of Four Hundred and Eighty Times in Twenty-four Hours* *.

IN our laſt Number we gave ſome account of the progreſs of the diſtillery buſineſs in Scotland; of the improvements that had been recently introduced there in the conſtruction of the ſtills; and of the cauſes that led to theſe improvements.

A memorial, preſented to a Committee of the Houſe of Commons by Dr. Jeffrey, who was appointed by the Lords of the Treaſury to examine the works of the diſtillers in Scotland, contains much curious and uſeful information on this ſubject; and, indeed, the whole of the Reports of the Committees on the Scotch Diſtilleries in 1798 and 1799 are extremely intereſting.

The ſtill deſcribed in our laſt was a great improvement; but the one we are about to deſcribe is ſo powerful that hardly any evidence ſhort of that with which the fact is ſupported, could make it credible. But the evidence is complete; for it is that of the diſtillers themſelves, whoſe intereſt it evidently was to depreciate rather than over-rate the power of their ſtills, the duty paid on the content of the ſtill having been from time to time increaſed in proportion to the acquired dexterity with which they were able to work it off.

We have already mentioned, that the firſt grand improvement was that of increaſing the width and diminiſhing the depth of the ſtill, by which a greater ſurface was expoſed to

* Extracted from the Reports of the Committees of the Houſe of Commons on the Scotch Diſtilleries, 1798, 1799.

 the

the action of the fire, and consequently a quicker evaporation produced. To lessen the possibility of the still running foul, and to hasten the escape and consequent condensation of the vapour, seemed to be the only points necessary to the perfecting of the process.

Dr. Jeffrey describes a still which seems well calculated to answer every end that can be desirable in such an utensil. It was constructed by Mr. Millar, a Scotch distiller of great ingenuity. Dr. Jeffrey called Mr. Millar's notice to the giving the free and most direct escape to the steam. "After mentioning to him," says Dr. Jeffrey, "that M. Beaumé had contrived a still that had many apertures in the head, and that he had found that the more of these openings he made the faster did the distillation go on, Mr. Millar set about constructing another very flat still, on the principle of giving exit to the steam at as many points in the shoulder of the still as possible. Fig. 1. Plate V. is a bird's-eye view of the apertures in the shoulder of this still before the pipes be fitted into them. Plate IV. is an outside view of the still, with its external machinery. Fig. 2. Plate V. is a perpendicular section, showing the central pipe, large below, and tapering as it rises perpendicularly upwards. The lateral pipes are oblique, truncated cones, flattened at the sides, as they ascend, to open into the central pipe. Immediately above that part of the central pipe where the lateral pipes enter, the jet and froth-breaking fly plays, while the liquor-agitating and sediment-scraping engine is worked, by machinery, below. The depth of the body is only $2\frac{1}{2}$ inches at the centre; and, at the sides, the sole and shoulder meet at an acute angle. No sooner was this still set to work, than it was evident that the principle on which the shoulder was constructed was just; for, though the body and head held 52 or 53 gallons only, the still could work with 22 gallons of wash, if the workmen were careful; but steadily, and without foul running, for a day together, with 20 gallons; and the time between charge and charge was only three minutes at an average. I have, however, seen this still charged and discharged 21 times within the hour. In a letter, which I received a few days ago from Mr. Millar, he informs me, 'that

'that he has made a new ſtill, of the ſame kind, that contains only 40 gallons in the body and 3 in the head, 43 gallons in all; and that the ſtate of working with this ſtill is as follows:—From the commencement of the charge till the word is given to let off, $2\frac{1}{4}$ minutes; time of diſcharging, $\frac{1}{2}$ minute; making the time of charging, running, and diſcharging, $2\frac{3}{4}$ minutes only, which is almoſt 22 times in an hour. The quantity of the charge of waſh is 16 gallons, which is two-fifths of the whole content, or $2\frac{1}{2}$ gallons more than one-third full. The charge of low wines is 24 gallons; the time of diſtilling from 9 to 10 minutes.' This, in ſo far as I know, is the faſteſt going ſtill in Scotland; and, when I ſay Scotland, I believe I may ſay the world."

The following is a more particular deſcription of the ſtill alluded to:—

Plate IV. Fig. 4. a view of the new ſtill, with its ſediment-agitating and jet-breaking apparatus.

Fig. 1. Plate V. ſhoulder of the new ſtill turned up, to ſhow the place and ſize of the apertures through which the ſteam eſcapes; *a*'s, the ſteam-eſcape apertures; *b*'s, the plain ſurfaces between the apertures.

Fig. 2. (Plate V.) a vertical ſection of Fig. 4. Plate IV. to ſhow its internal apparatus; *a*, the bottom of the ſtill joined to *b* the ſhoulder with ſolder, or riveted, or ſcrew-nails and lute; *c*, the turned-up edge of the bottom, againſt which, and on a level with *a*, the brick-work of the coping of the flue reſts, preventing the flame from getting up to touch *c*; *d*, the diſcharge-pipe. N. B. Neither the charge-pipe, nor ſight or ſoap-hole are ſhown. *e*, *e*, the body of the ſtill; *f*, ſection of the central ſteam-eſcape pipe; *g*, ſection of one of the lateral ſteam-eſcape pipes; *h*, outſide view of another; *i*, *i*, *i*, *i*, inferior apertures of lateral ſteam-pipes; *k*, *k*, *k*, *k*, ſuperior apertures of ditto; *l*, *l*, bottom-ſcraper or liquor-agitator, which may either be made to apply cloſe to the bottom, or to drag chains; *m*, the upright ſhaft of this engine, as it is called; *n*, horizontal wheel of ditto, with its ſupporters; *o*, vertical wheel of ditto; *p*, its handle and ſhaft; *w*, ſupport of ſhaft; *r*, froth and ebullition jet-breaker reſting on the croſs bar *s*; *t*, its upright ſhaft; *u*, cup-mouthed collar of ditto, filled

with wool and greafe, held down by the plate and fcrews formerly defcribed; *v*, general fteam-efcape pipe, or head.

Fig. 3. alterations propofed to be made in the form of the apertures to facilitate the efcape of the fteam, by taking away a great part of the fhoulders on which it muft otherwife impinge: *a*, the verge of the fhoulder; *b*, the central aperture; *c*, the lateral apertures; *d*, the fpaces between them. It is hardly neceffary to add, that as the lateral apertures are very large at their bafe, the pipes muft contract more quickly near the bafe than higher up.

The following defcription of the mode of carrying on the procefs of diftillation at Cannon Mills, near Edinburgh, in 1798, before the improvements had been carried to their prefent pitch, will ferve to give our readers fome idea of the expertnefs and fteady regularity of the people employed:—

In this work there are two ftills generally ufed for diftilling wafh; thefe ftills contain fifty-five or fifty-fix gallons in the body, and twenty-nine in the head of each; are charged with wafh up to the fight-hole, which may be within four or five gallons of the full content of the body. A very ftrong fire is put into the furnace below the ftills; there are a quantity of iron chains affixed to a fpindle, which a man, who ftands on the top of the furnace, turns round, and the chains fweep round on the bottom of the infide of the ftill all the time that the wafh is coming to boil, and when the fpent wafh is running off. If the wafh fhould rife up too far in the act of boiling, and which is known by a man who keeps ftriking the head of the ftill with a ftick, he gives the alarm to another man, whofe fole bufinefs is to attend the furnace, and who inftantly dafhes a pailfull of cold water on the bottom of the ftill, and on the fire, which caufes the wafh to fall down; the fire is then ftirred up to a very ftrong heat, and this procefs goes on till the fteam is condenfed, and the low wines run off clear. There is another man who attends at the end of the worm, where the low wines run off into a receiver, who is called the *ball-man*, and who, with an inftrument, examines the low wines as they run off; and when he finds there is no more fpirit remaining in them, calls out *let go*, upon which every man employed about the ftill is at his poft. He who

who attends the discharge cock turns it about, and the spent wash runs instantly off; which done, he gives the signal to the man on the top of the furnace, who having opened the sight-hole, turns the charging cock, and fills the still as before with fresh wash; the furnace-man dashing in coals, and the other man turning all the time the iron-work round; and the same process goes on again day and night, and the discharging the spent wash, and renewing the charge, is done in a few seconds.

The low wine still is wrought much in the same way, with this difference, that the fore-shot, as it is called, which is the first of the spirits that come off, is kept from the spirits, and returned back into the next or some succeeding operation, as are also the faints or spent low wines; the discharge of the spirits is likewise attended by a ball-man, who moves a cock placed in a receiver for receiving each separate kind, and which is done in the twinkling of an eye.

"It has been proposed," says Dr. Jeffrey, "to adapt a steam-engine to a still. There is no difficulty in effecting this: it may be said to be already accomplished, for Mr. Cartwright's steam-engine is a still and steam-engine conjoined; and it may be also observed, that a steam-engine fitted to a Scotch fast-going still would have great power; for the quantity of steam that rises from these stills in a given time is prodigious. Such an engine could grind the malt, turn the mash-stirring machine, work the pumps, &c. and it is, I think, likewise obvious, that under survey it would aid the excise in detecting frauds; for it would show when the still was at work. But however convenient and economical such a steam-engine-still might be in England, where the distiller may work when and how he pleases, it never can be profitably used in Scotland, where the distiller works against time. For, as the steam would be pent up in the still during the half of the time the beam of the engine makes a stroke, the distiller would lose that time: besides, as the heat accumulates in the wash when the steam is not allowed to escape, it is to be feared that the sediment would be frequently singed, and that of course the spirit produced would be tainted with empyreuma."

XII. *On*

XII. *On the Queſtion, whether the Sun, the Moon, and other heavenly Bodies are ſurrounded by Atmoſpheres.* By T. W. A. Murhard*.

THIS queſtion is of the utmoſt importance to the philoſopher as well as the aſtronomer; and the more ſo at the preſent period, as the diſpute between the ſo-called Atmoſpherians and Anti-atmoſpherians, which has been continued ever ſince the beginning of this century, is not yet ended. It relates in particular to the atmoſphere of the moon, which was ſo ſtrenuouſly maintained by Plutarch. But it would be as ridiculous to refer the conteſt to reaſon, as if we ſhould endeavour to give a deciſive opinion reſpecting a circumſtance with which we are totally unacquainted. It is certain that nothing on this point can be determined *a priori*; and therefore ſuch concluſions as are drawn from analogy muſt be conſidered as deciſive. The ſenſes muſt here be our guide; but it is much to be lamented, that our organs are often too weak, and our inſtruments too imperfect, notwithſtanding the great preciſion to which the latter have been carried in modern times.

But we muſt firſt endeavour to eſtabliſh what we mean in general by the term *atmoſphere*. By atmoſphere, I underſtand that delicate ſubtile body which immediately ſurrounds the planets, and which is mixed with thoſe heterogeneous particles diſſolved on their ſurfaces, or which evaporate from them. By this definition it is evident, that, according as the nature of the planet, and the particles diſſolved on its ſurface, are different, the atmoſpheres muſt neceſſarily be different alſo; ſo that, by knowing the phyſical nature of the ſurface of any of the planets, we can form a concluſion reſpecting the nature of its atmoſphere, and *vice verſa*. Of this we have a ſufficient number of inſtances in regard to the earth. Let us here only compare the pure air of the dry diſtricts of Arabia with the air of marſhy watery diſtricts, which is continually filled with vapours, clouds, and rain, and we ſhall ſoon be convinced of the truth of this poſition. But

* From *Neues Journal der Phyſik*, by F. A. C. Gren, Vol. III. part 4.

whether each of the planets is ſurrounded by ſuch a ſubtile maſs or not, is another queſtion, which our experience hitherto has left in the greateſt uncertainty, and reſpecting which we can form only probable concluſions *a priori*.

If we conſider the heavenly bodies at the period of their formation, it muſt naturally occur, that, when created, they muſt have had atmoſpheres; for, as ſoon as the fixed ſtars began to burn, let their ſubſtance be what it might, a great many particles muſt have thereby been diſengaged from them, and have formed a kind of atmoſpheres. Now, if each of theſe fixed ſtars is ſurrounded by a certain number of planets, its action on them muſt have ſeparated from them abundance of particles, which, on account of their levity, would immediately aſcend and form atmoſpheres around them: but as the diſengaged particles could not all have the ſame gravity, the lighter would riſe to a greater height than the heavier; and, on that account, the rarity of theſe atmoſpheres muſt have increaſed according as the diſtance from the planet was greater. The different aqueous, earthy, ſaline, ſulphureous, and mineral particles form therefore in the air, belonging to each planet, what ought properly to be called its atmoſphere *.

That the ſun has an atmoſphere is admitted by all the modern aſtronomers. Peyroux de la Coudreniere has in particular aſſerted, in modern times, and his opinion has been almoſt univerſally adopted, that the ſun is not a ball of fire, but that his light comes entirely from a luminous atmoſphere by which he is ſurrounded, and which is filled with a highly inflammable vapour that forms a continual covering of fire. According to him, therefore, the ſun is a prodigious burning mirror, which can effect with leſs waſte much more than it could do were it a globe of fire. M. Schröter concludes alſo, from his obſervations, that the light of the ſun ariſes from the luminous matter by which he is ſurrounded; ſo that hopes are entertained that, in the courſe of time, by making fre-

* Heinſius, in his *Betrachtungen über den kometen von* 1744, *Peterſburgh* 1774, 4to. p. 101, makes the boundaries of each atmoſphere to be in that point where the particles extricated from the planet are in equilibrium between it and the ſun.

quent

quent obfervations of the fpots and faculæ, we fhall be able to obtain a chart of the fun, as we have obtained one of the moon: for, according to this hypothefis, the fpots of the fun are not clouds and thick vapours that arife from the opaque body of the folar orb. According to Peyroux de la Coudreniere, all the planets are ftill approaching nearer to the nature of the fun; and, in his opinion, Venus, Jupiter, and Saturn, would not exhibit fuch a luminous appearance were they enlightened merely by the fun. He concludes, therefore, that abundance of inflammable vapour muft afcend into their atmofpheres, and, by taking fire, increafe their light. According to him, our earth acquires a confiderable light from a like caufe: and this indeed is not altogether improbable; for I myfelf, with a telefcope of a great magnifying power, have frequently obferved the heavens, by day as well as night, for this purpofe alone, and have feen, in a quarter of an hour, a great many inflammations of this kind in the atmofphere. Peyroux de la Coudreniere, however, goes too far when he believes that Saturn, the remoteft of the planets, feems as if inclining to remove from our fyftem altogether; to convert himfelf into a fun, and to have planets revolving around him. This conceit is fufficiently refuted by the difcovery of Uranus (the Georgium fidus) by Dr. Herfchel.

Upon the whole, we have no certain grounds on which we can reafon refpecting the atmofpheres of the planets. Becaufe our earth has one, and is a planet, it does not thence follow that the reft muft have atmofpheres. We indeed find every where in nature the greateft diverfity and variety; and if we always formed conclufions from analogy, we fhould fall into the greateft abfurdities and errors.

M. Schröter, from the alternate obfcurity and bright appearance of Jupiter, which he has obferved, thinks himfelf authorifed to conclude, that the atmofphere of Jupiter, in general, has a great fimilarity to ours*. It is very remarkable, adds he, that the whitifh and light zones are not always perfectly bright, but in common feem to be covered with a thin atmofpheric matter, and to have fometimes a more luminous appearance than at others. It is not impro-

* See his *Beyträge zu den aftronomifchen entdeckungen*, Berlin 1788. 8vo.

bable

bable that the ſurface of Jupiter may reflect a very lively and white light, according to the nature of its component parts, with which we are unacquainted. The ſtripes obſerved on the ſurface of that planet lie in a poſition parallel to his equator; are ſubject to a great many variations; and, in general, are conſidered to ariſe from atmoſpheric matter liable to accidental changes. The ſame thing may be conjectured in regard to Saturn, on which there are ſtripes of the ſame kind, according to the late diſcoveries of Dr. Herſchel. But in regard to the atmoſpheres of Mercury, Venus, Mars, and Uranus, our concluſions muſt be attended with ſtill leſs certainty. If they have any, they muſt be far more ſubtile, and finer, than that of our earth; elſe theſe bodies would not always appear with ſo much brightneſs. The exiſtence of an atmoſphere around Mars has, indeed, been rendered highly probable by Dr. Herſchel and Mr. Schröter; and the latter thinks he obſerved a crepuſculum of $15\frac{1}{2}°$ in Venus, which ſeems to ſuppoſe that it has an atmoſphere *.

In regard to comets, I can the leſs venture to hazard any aſſertions, as ſome of our modern philoſophers conſider them to be merely nebulous bodies; I ſhall therefore confine what I have to ſay, to the moon, which ſtill remains to be taken into conſideration, and reſpecting the atmoſphere of which there has been the moſt diſpute. Towards the end of the ſixteenth century it was ſtrenuouſly maintained by Kepler. In the ſeventeenth the ſame opinion was entertained by Kircher, Scheiner, Möſtlin, Fabricius, Bulliald, Hevelius, &c. In the preſent it has been adopted by Louville, Maraldi, Fontenelle, Bianchini, Carbone, Wolf, Boſcovich, Euler, Du Sejour, Herſchel, Schröter, &c. Thoſe who oppoſed this opinion were, Huyghens, Caſſini, Malezien, De la Hire, De l'Iſle, Mylius, Tobias Mayer, Grandjean de Fouchy, &c.

Thoſe who maintain that the moon has an atmoſphere found their opinion on the following grounds:—

1. During total eclipſes of the ſun, a light ring has been ſeen around the moon parallel to her limb. This pheno-

* See *Bodes Aſtronom. Jahrbuch* 1793, p. 251.

menon was obferved, in particular, during thofe remarkable total eclipfes of the fun in the years 1706 and 1715. That of the 12th of May 1706 was obferved in London by Halley; in Paris, by Caffini and De la Hire; at Montpellier, by De Plantade; at Berlin, by Hofmann; at Leipfic, by Baron Von Wolf; at Drefden, by Tfchirnhaufen; at Nuremberg, by Wurzelbau; at Jena, by Hamberger; at Zeitz, by Teuber; and at Breflau, by P. Heinrich.

On this occafion Caffini, De la Hire, De Plantade, Wolf, Wurzelbau and Heinrich obferved, during the greateft darknefs, a light ring around the moon; but, on the other hand, Hofmann and Teuber perceived nothing of the kind; and thofe who faw the ring differ very much from each other in the accounts they have given of its magnitude and colour.

The eclipfe of the fun on the 3d of May 1715 was obferved at London by Halley and Louville in particular, and a ring of the fame kind was obferved. Rings of the like kind have been obferved alfo at various periods.

2. Many aftronomers obferve, that the planets fometimes when they approach the moon's limb have a coloured appearance, change their round figure, and feem to affume that of an ellipfe. It has often happened that a planet at its ingreffion has appeared perfectly round, and at its egreffion quite diftorted; or, *vice verfa*, diftorted at its ingreffion, and round on its egreffion. The latter cafe I once obferved myfelf, in regard to Venus; the former was feen, in regard to Jupiter, by M. Kaftner at Leipfic. This phenomenon takes place not only with the planets but alfo with the fixed ftars, as is proved by a multitude of inftances both old and new; fo that it feems to be a fact eftablifhed beyond all difpute.

3. It is faid to have been remarked during folar eclipfes, that the limb of the fun trembles before the moon entirely touches it.

4. The diameter of the moon is faid to have been obferved fmall at the beginning and end of the darknefs during eclipfes, and greater at the time of the greateft darknefs. On this circumftance Teuber founds his proof for the exiftence of a lunar atmofphere. Euler, from the diameter of the fun appearing

pearing to be magnified during the annular solar eclipse of 1748, concluded also that the moon has an atmosphere *.

5. The moon, during serene weather, when stars of the seventh magnitude could be seen, has totally disappeared, so that she could not be discovered by the best telescopes. Several instances of this kind are related by Kepler in his *Astronomiæ pars optica* †, and by Copernicus in his Epitome of Astronomy ‡. The same thing was observed by Hevelius, Riccioli, &c. It is worthy of remark, that at the time when the moon disappeared to Riccioli, she disappeared suddenly also in Holland.

6. Several astronomers have found that the moon does not always appear equally bright and clear. Hevelius says, that at various times, though the weather was equally serene; though the moon had the same altitude, and was at the same distance from the earth; and though he used the same telescopes, her spots did not appear equally bright and distinct, but were more apparent at some times than at others. The same thing was observed by Erasmus Francisci, and Bulliald; and before them, by Möstlin.

7. Fiery phenomena have been seen on the moon; and from this circumstance some have concluded that she has an atmosphere. Kolben saw in 1705, not far from the line, thirty hours after new moon, the two horns of that luminary touch each other; so that she formed, as it were, a bright ring. It is related in the Breslau Collections §, that some people saw the moon, the day after she had been new, as bright as if she had been full; and Siegesbec says, in the same work ||, that in 1724, two days after new moon, he saw the same phenomenon as that observed by Kolben.

From all these circumstances it might be concluded that the moon has an atmosphere; but to these grounds, others, perhaps equally strong, might be opposed. These proofs for the other side of the question may be found in Mylius's

* See Sur l'Atmosphere de la Lune prouvée par la derniere Eclipse annulaire du Soleil, par M. Euler, in the Mem. de l'Acad. Royale des Sciences de Berlin 1748, p. 103.

† Pages 227, 297. ‡ Lib. V. p. 825.

§ See Breslauischen Sammlungen, XV. p. 270. || XXVI. p. 522.

Thoughts on the Lunar Atmoſphere *, and T. Mayer's Proofs that the Moon has no Atmoſphere †: but, without tranſcribing them, I ſhall here give a ſhort view of them, and in the ſame order as I have related the grounds on which the opinion of the lunar atmoſphere is founded.

In regard to the bright ring (1) which has appeared round the moon during total ſolar eclipſes, it is evident that, even if we admit that the moon has an atmoſphere, it muſt have been occaſioned by its refraction. But experience has ſhown that bright rings of the like kind are produced around all opaque bodies when they are placed oppoſite the ſun or any ſtrong light. This was found to be the caſe by De la Hire, who oppoſed this circumſtance to the opinion of Louville, who was a ſtrenuous advocate for the lunar atmoſphere. For this purpoſe he took an unpoliſhed globe of ſtone, and, placing it between his eye and the ſun, ſaw the interior edge of the ring, which was formed around it, broken and uneven, as Louville had ſeen the interior part of the ring around the moon. A like experiment was made by De l'Iſle junior. He cauſed the rays of the ſun to paſs through a ſmall hole into a darkened room; held a circular piece of lead between him and the ſun; and obſerved, on a ſheet of white paper, that the ſhadow of the lead was evidently ſurrounded by a luminous ring ‡. John Caſſini explained the ring ſeen around the moon during total eclipſes of the ſun from the ſolar atmoſphere; and this was carried ſtill farther by De Plantade. But this explanation is not neceſſary, as it appears that the whole phenomenon may be explained as well, if not much better, from refraction. Du Sejour, however, is of opinion, that refraction of the ſun's rays at the moon's limb cannot be admitted unleſs we firſt admit a lunar atmoſphere: and he ſhows, from Short's Obſervation of the Solar Eclipſe in 1764, that the refraction of the ſun's rays which touched the moon's limb amounted to $4\frac{1}{2}''$.

* Gedanken über die atmoſphäre des mondes, *Leipſic* 1746, 4to.

† Koſmologiſche nachrichten und ſammlungen auf das jahr, 1748. *Nurn.* 1750, 4to. p. 397.

‡ See his Paper on the Atmoſphere of the Moon, in the *Memoires de l'Academie des Sciences* for 1715. *Paris* 1718, p. 147.

One

One of the lateſt inſtances of ſuch a ring around the moon is that ſeen on the 24th of June 1778, by Don Antonio de Ulloa, between Tercera and Cape St. Vincent *. Five or ſix ſeconds after the ſun was completely covered, a very bright ring began to be ſeen around the moon; and this ring ſeemed to be in a continual and violent motion round the moon's circumference. The nearer the moon approached to the centre of the ſun, it always became brighter and more luminous. Its colour was not every where the ſame: next to the moon's limb it was reddiſh; then of a pale or gold-yellow colour; and towards the exterior edge it always became whiter: but it was every where equally luminous and beautiful. All the parts of the ring ſeemed to be carried round the moon with the ſame velocity, without the order of the colours being confounded. Every thing before obſerved, in regard to this luminous ring, might be explained from refraction; but the circumſtance, never obſerved on any other occaſion, of its moving with a continual and uniform motion around its centre, if this was actually the caſe, and if it did not ariſe from ſome deception in the organs of ſight, makes a new, and, according to every appearance, an almoſt inſuperable difficulty in the explanation. It is much to be lamented that we are likely to remain in this uncertainty a conſiderable time; for, according to a calculation of M. Du Vaucel †, a total eclipſe of the ſun, viſible at Paris, will not take place for 120 years, and none can occur viſible in any part of Europe till the year 1816 ‡. From the above obſervation Don Antonio de Ulloa does not heſitate to conclude that the moon has an atmoſphere.

I ſhall now proceed to the ſecond point, adduced as a proof of

* See his *Obſervation de l'Eclipſe du Soleil totale du 24 Juin* 1778, in Rozier's *Journal de Phyſique*, Vol. XXV. part 1. April 1780, p. 319; alſo *Mem. de l'Acad. Royale des Sciences à Paris* 1778, Paris 1781, p. 64; and Don Antonio de Ulloa's Obſervations on the total Eclipſe of the Sun on the 24th of June 1775, in the Swediſh Tranſactions, Vol. XL. *Leipſic* 1783, p. 225.

† Vol. V. Des Memoires preſentés.

‡ See Peter Wargentin's Paper on the luminous Ring with which the Moon ſeems to be ſurrounded when ſhe entirely covers the Sun, in the Swediſh Tranſactions for 1778, Vol. XL. p. 251.

of the moon having an atmosphere. Some suspicion is excited in regard to the accuracy of this observation, because many astronomers, during the same celestial occurrences at other times, have never observed the smallest change of figure in the stars either during their ingress or egress. De la Hire *, however, observed, during an occultation of Jupiter by the moon, that when Jupiter was at the distance of 12′ from the moon, he showed the same lively colours as when he approached nearer. But, to make these colours appear, it was necessary that Jupiter should be at the edge of the aperture of the telescope; for when he was in the middle of it none were seen. From this circumstance he naturally concludes, that the colours did not proceed from the moon, but from the glasses of the telescope, which, as they are convex, form at their edges a sort of circular prism. Venus, which appeared soon after, exhibited the same colours as Jupiter. T. Mayer, therefore, gives this excellent rule: Make the experiment without prejudice, and take care to use the telescope with the necessary precaution: it will then, perhaps, be found, that the planets and fixed stars approach the moon at all times in their proper form. De l'Isle ascribed this phenomenon to the inflexion of the rays alone †.

We now come to the third argument adduced in favour of the lunar atmosphere, or the tremulous motion of the sun's limb before he touches the moon during a solar eclipse. This undoubtedly arises from our atmosphere alone; and we have so many instances of such quivering on other occasions, that I do not think it necessary to say any thing farther respecting it. This is certainly one of the weakest proofs advanced in favour of a lunar atmosphere.

In regard to the fourth proof, that the diameter of the moon at the commencement and end of eclipses has been observed to be smaller, and at the time of the greatest darkness to be greater, it appears to be almost void of foundation; and indeed we have more instances of such a phenomenon not being seen, than of its being observed. During the total

* Memoires de l'Acad. de Paris 1715, p. 148.

† Mem. pour servir à l'Histoire et au Progrés de l'Astronomie. *Paris* 1738, p. 249.

solar

ſolar eclipſe of 1669, nothing of the kind was diſcovered; and this was the caſe in regard to that of 1706, which Hofmann obſerved at Berlin. Tobias Mayer, alſo, during the great total eclipſe of the ſun in 1748, though he made his obſervation with the utmoſt attention, could perceive no ſuch thing.

I muſt now ſay a few words reſpecting the fifth and ſixth proofs. The cauſe of both theſe phenomena lies, no doubt, in our atmoſphere, and not in that of the moon; for the phenomena have been ſeen in one place and not in another.

Theſe are the grounds on which the exiſtence of the lunar atmoſphere may be conteſted: but it appears to me, that we ſhould decide too raſhly were we to deny altogether that the moon has an atmoſphere; for we may ſtill admit one, though it may be of ſuch a nature as to elude our ſenſes. There are many things in nature which our imperfect organs of ſenſe are incapable of perceiving; but it would be ridiculous on that account to deny their exiſtence. I need only requeſt the reader to recollect the phenomena of general gravity or attraction, magnetiſm, &c. This much, at any rate, is certain, that if the moon has an atmoſphere, it muſt be of a nature totally different from that of our earth. This will appear the more evident, if we conſider that, according to all the obſervations hitherto made, the moon does not abound with ſuch ſeas and rivers as our earth. M. Schröter conjectures, that as the moon, in regard to the ſun, turns round her axis only once in 29 days 12 hours, this monthly change of day and night may probably have a conſiderable influence on the lunar atmoſphere, and ſupply the place of our ſeaſons. Of this he is the more convinced by the monthly change in the colour and ſpots of the moon which he has remarked. The atmoſphere of the moon muſt be different from that of the earth, not only in regard to its brightneſs and tranſparency, but alſo in regard to its power of weakening and breaking the rays of light. But on this ſubject nothing deciſive can be obtained from all the obſervations hitherto made *.

* See Schroter's Obſervations on the Atmoſphere of the Moon in the *Götting. gel. Anzeig.* 1792, No. 86.

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We are equally ignorant in regard to the solar atmosphere, which is said to give rise to the so called zodiacal light. In that case, however, it must not be of a globular form, like our atmosphere, but extend round the sun's body like a kind of zone. From this solar atmosphere M. Mairan * deduces the northern lights; but this opinion has been, in some measure, refuted by d'Alembert †.

The result of what has been here said, is, that respecting the atmospheres of the celestial bodies we know very little; and as the observations on this subject require to be made with the utmost accuracy and attention, it will be a long time before our knowledge on this head can be much enlarged. It is to be hoped, however, that those who possess acuteness of sight, and good instruments, will endeavour to determine this point, for which no person seems fitter than Dr. Herschel.

XIII. *On the Advantages which result from substituting Oak Bark for Gall Nuts in dyeing Black, especially in dyeing Hats.*

DIMO STEPHANOPOLI, a Corsican, and a surgeon in the French army so far back as the year 1782, proposed oak bark as a substitute for galls; and the examination of his process was referred by the Government first to Macquer, who gave a favourable report of the result, and afterwards to Berthollet, who was of a different opinion. Several other means for determining the advantages or disadvantages likely to result from a general adoption of the process were had recourse to. Lately it was revived by the Lyceum of the Arts, from whose report we extract the following account:—

"Experiments were made, by order of the College of Pharmacy, at the manufactory of Beaujolin and Morel. Two boilers, of about two hundred and twenty hats each, were made ready, one for the gall nuts and the other for the bark.

* See his Traité Physique et Historique de l'Aurore Boreale, second edit. *Paris* 1754, 4to.

† See his Opuscules Mathematiques, Vol. VI. p. 334.

bark. Twelve hats in each were marked: they were of the ſame ſtuff and the ſame ſize, had been prepared with all the precautions which each of the two methods required, and the whole proceſs was carefully obſerved by a commiſſioner who attended for the purpoſe. After all theſe hats had been properly dried, cleaned, and bruſhed, they were placed indiſcriminately on a table. Several of the moſt expert dyers of Paris were invited to ſelect, from the twenty-four hats, the twelve which ſhould appear to them to be the beſt dyed. Theſe dyers arrived ſeparately at two different times, ſo that there were two ſelections; and in both caſes, one hat excepted, theſe dyers pointed out as the beſt dyed thoſe hats which had been treated with oak bark. Was any thing more neceſſary to determine which method deſerved the preference? The fate of this new proceſs however, which to ſucceſs in the operation of dyeing, unites economy, and the advantage of freeing us from paying tribute to a foreign nation, has remained in a ſtate of uncertainty.

" One of the ſtrongeſt objections which has been made to dyeing black with oak bark, is the conſiderable difference between the quantities of the precipitates; and we muſt ſay, for the information of thoſe unacquainted with the ſubject, that the black matter of the dye, of which we here ſpeak, reſults from the combination of an acid, called the gallic, with iron; and in the operation we are deſcribing, the quantity of this acid is generally determined by knowing how many parts of iron (furniſhed by ſulphat of iron, commonly called *green copperas*,) have gone into a known quantity of the precipitate: the remaining parts which are neceſſary to make up the known quantity are counted as gallic acid.

" If the decoction of a given quantity of gall nuts be poured on a ſolution of the ſulphat of iron, you obtain a black precipitate; and if the ſame operation be performed with a decoction of oak bark, and in the ſame quantities, you will have alſo a black precipitate, with this difference, that the gall nuts will have produced eight or ten times as much as the oak bark: but this abundance in the gall nuts is only apparent, and is owing to a ſort of feculent matter, or gum, which adheres to the acid and is carried down with the precipitate,

cipitate, where it cannot but diminiſh the intenſity of the black. In a word, to be convinced of theſe truths, it will be ſufficient to give a comparative view of the two proceſſes, and of their reſults. We ſhall ſuppoſe, therefore, a kettle for twenty-five dozen of hats, as is the caſe in ſeveral manufactories. That quantity will require twenty-five pounds of gall nuts and the like quantity of ſulphat of iron, about 150 or 200 pounds of logwood, and twelve pounds of acetat of copper (verdegris), and from 100 to 125 pails of water. The gall nuts and logwood muſt be boiled for about ſix or eight hours, which will reduce the decoction to about a third. The fire is then diminiſhed, to throw in, portion by portion, the ſulphat of iron and the verdegris. In this manner the bath is prepared, and you plunge into it the felt or hats, which are to be drawn out and again immerſed different times, as experience has ſhown that atmoſpheric air contributes a great deal towards the efficacy of the operation of the dye. There is ſome difference in the method of manipulation; but this depends on the practices followed in different manufactories: in regard to the doſes, they are nearly every where the ſame.

" The method of Dimo Stephanopoli conſiſts merely in ſubſtituting oak bark in the ſtead of gall nuts in the proportion of a half, that is to ſay, twelve pounds and a half inſtead of twenty-five. It requires no other preparation before it is employed than to be cut, or coarſely broke.

" This bark furniſhes a dye much fuller, as well as more beautiful and more durable; and the operation becomes much eaſier, for it is not ſubject to what is called burning. It is free from an immenſe quantity of ſediment, which is found in the bath when gall nuts are employed, and which communicates a duſt that can be removed only by a rod or bruſh, which, however, requires tedious and troubleſome labour.

" By forming an eſtimate at the uſual prices, in the operation above mentioned, the gall nuts employed coſt 75 francs, and the oak bark 14 ſous*. Janin, in the ſtreet Avoie, proprietor of one of the largeſt hat manufactories at Paris, and

* One hundredth of the price of the galls.

who

who dyes twenty-five dozen of hats at a time, has employed for ten years, with conſtant ſucceſs, the proceſs of Stephanopoli. He aſſures us, that from his own experience oak bark deſerves in every reſpect to be preferred to gall nuts.

Morel, hatter, near the gate of St. Martin, one of thoſe who firſt employed the proceſs of Stephanopoli, has never diſcontinued it. Huaut, in the ſtreet des Meneſtriers, had formed an eſtabliſhment for dyeing hats, but for want of proper encouragement he was on the point of abandoning his enterpriſe. Morel, however, adviſed him to pay a viſit to Stephanopoli, from whom he obtained the proceſs; and ſince that time he has ſucceeded. He declares that he is under the greateſt obligations to Morel, and the author of this new method. He regularly heats a kettle of 300 hats every twenty-four hours. Both Janin and Morel have for ſeveral years paſt received many letters from their cuſtomers reſpecting the beauty and durability of the dye of their hats, and, according to their declaration, only ſince they employed oak bark.

" It reſults from what has been ſaid, that oak bark is preferable, in every reſpect, to gall nuts: that, being a production of our own ſoil, it will free us from paying tribute to foreigners; and that a ſcarcity of gall nuts, or accidents which may happen to prevent a ſupply of that article, can no longer hurt the manufacture of hats in France, which is of ſo much importance, and that of wool dyed black, &c.

" We have not entered into all the details which this ſubject would admit; it is ſuſceptible of great extenſion, and, in many reſpects, may be conſidered as new. It cannot be doubted that the operation called *galling* might be performed with oak bark, and it is to be regretted that the reſearches of Lapalle, Member of the Conſtituent Aſſembly, on this object were not publiſhed.

" The uſe of oak bark was already known in ſome branches of dyeing, and this uſe of it had been mentioned by ſeveral authors. To conclude: We are certain that, in the diſpute reſpecting oak bark and gall nuts, the views of each party were equally pure; but experience alone was able to remove every difficulty, and the Aſſembly muſt have ſeen that there

remains no longer any doubt reſpecting the importance of the ſervice rendered by Stephanopoli. His method will be introduced and extended in our manufactories, to the advantage of ſeveral branches of induſtry and of the general intereſt."

XIV. *Some Account of the late* Peter Charles Le Monnier.

Peter Charles Le Monnier, the oldeſt aſtronomer in Europe at the time of his death, which happened on the 2d of April 1799, at Lizieux in Normandy, was born at Paris on the 20th of November 1715. At a very early period of life he applied to the ſtudy of aſtronomy, and made his firſt obſervation of the oppoſition of Saturn on the 23d of September 1731, when he was only ſixteen. At the age of twenty he was choſen a member of the Academy of Sciences at Paris. In 1735 he was ſent to Lapland, along with Maupertuis, to meaſure a degree of the earth. In 1748 he accompanied Lord Macclesfield to Scotland to obſerve the annular eclipſe of the ſun, which could be ſeen with moſt advantage in that country; and he was the firſt aſtronomer who had the pleaſure of meaſuring the diameter of the moon on the ſun's diſk.

Louis XV. who was fond of and patroniſed aſtronomy, ſhowed a great eſteem for Le Monnier. When his Majeſty wiſhed to obſerve any of the celeſtial phenomena, he always attended him; and it appears, by the memoirs of the Academy of Sciences at Paris, that the King obſerved in this manner, at his country palace of St. Hubert, both the tranſits of Venus over the ſun's diſk in the years 1761 and 1769. It is worthy of notice, and deſerves to be here recorded, how much his Majeſty ſeemed to be intereſted in the ſucceſs of theſe obſervations, and how careful he was not to interrupt the aſtronomers during the courſe of their operations. Le Monnier, in his paper on this ſubject in the Memoirs of the Academy, ſays —" His Majeſty perceiving that we conſidered the laſt contact to be of the utmoſt importance, we were at that moment ſurrounded by the moſt profound ſilence."

ſilence." During the tranſit of Venus in 1769, his Majeſty allowed that able naval officer the Marquis de Chabert, who had juſt returned from a ſcientific voyage to the Levant, to have a ſhare in the obſervations made on that occaſion.

In the year 1750 Le Monnier was requeſted by the King to draw a meridian line at the palace of Belle-vue, where he often made obſervations; and his Majeſty for this ſervice gave Le Monnier a preſent of 15,000 livres (about 600*l.* ſterling). In 1742 his Majeſty gave him a houſe in *Rue de la Paſte* at Paris, where he reſided and made obſervations till the period of the Revolution. In 1751 the King preſented him with a block of marble eight feet in height, ſix in breadth, and fifteen inches in thickneſs, in order that he might affix to it his five feet mural quadrant. This large maſs of marble, with all the inſtruments attached to it, moves on a large braſs globe, by which the quadrant can be turned from ſouth to north, and by which the great eight feet mural quadrant, which is faſtened in an immoveable poſition to a wall fronting the ſouth, can be adjuſted.

With theſe quadrants Le Monnier, for the ſpace of forty years, obſerved the moon, with unwearied attention, at all hours of the night. No perſon but a diligent aſtronomer can know to what inconveniences one is expoſed in making an uninterrupted ſeries of obſervations of the moon. As the moon, during one revolution, may paſs the meridian at every hour of the day and the night, which is the moment for obſervation, the aſtronomer who purſues theſe obſervations muſt be prepared at all hours of the day and night, and ſacrifice ſleep and every other enjoyment.

Le Monnier was Lalande's aſtronomical preceptor; and the ſcholar has, indeed, ſhown himſelf worthy of the maſter. The diſcerning mind of Le Monnier could readily foreſee in young Lalande, then only ſixteen, what the courſe of a little time afterwards confirmed. In the twentieth year of his age Lalande, on the recommendation of his preceptor, was elected a Member of the Royal Academy of Sciences; and in 1752, on a propoſal made by him, he was ſent to Berlin along with La Caille, who afterwards undertook a voyage to the Cape of Good Hope to make correſponding obſervations, in order

to determine the parallax of the moon, which never had been accurately aſcertained. On this occaſion Le Monnier lent to his pupil his five feet mural quadrant. His zeal for the promotion of aſtronomy was boundleſs; and therefore Lalande ſays, in his *Notice des Travaux du C. Le Monnier*, "I myſelf am the principal reſult of his zeal for aſtronomy."

Le Monnier was naturally of a very irritable diſpoſition, and, though warm in his friendſhip, was eaſily offended: in that caſe his hatred was irreconcileable. Lalande, as he ſays himſelf, had the misfortune to incur the diſpleaſure of his preceptor, for whom he entertained the utmoſt affection, and whoſe good graces he was never able to recover. But Lalande never ceaſed to ſhow his eſteem and gratitude for him till the lateſt day of his life. "I never ceaſed to declare," ſays Lalande, "as Diogenes did to his maſter Antiſthenes, You will never find a baton ſufficiently heavy to drive me away from you." In the year 1797 Lalande wrote an eulogy on Le Monnier for the *Connoiſſance des Tems, année* 9, which diſplayed the utmoſt reſpect and eſteem of the pupil towards his preceptor; but Le Monnier would never read it *.

Hennert, that celebrated geometrician and profeſſor of mathematics at Utrecht, may alſo be conſidered as a ſcholar of Le Monnier, as appears by the following extract from one of his letters, dated May 26, 1797:—"Le Monnier is an acute and philoſophic aſtronomer. I learned a great deal from him while I reſided at Paris, though I lodged at the houſe of the late De l'Iſle, where I often obſerved with Meſſier. Le Monnier was a great friend of D'Alembert, and conſequently an opponent of Lalande."

Le Monnier left behind him a great many valuable manuſcripts and a multitude of excellent obſervations, which he was very fond of keeping to himſelf, and which, in the latter period of his life, he never made known. Beſides others, he had a ſeries of important obſervations of the moon, and a great many obſervations of ſtars, made for a catalogue, which

* It may not be improper here to remark, that Lalande had a great friendſhip and reſpect for that eminent aſtronomer La Caille, whom Le Monnier mortally hated. Le Monnier and D'Alembert were alſo great friends, but Lalande had no kind of intimacy with the latter.

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he announced so early as the year 1741, and among which there were two of the new planet Uranus. The more he was entreated to communicate them to the public, the more obstinate he became in withholding them; and he even sometimes threatened to destroy them. When the Revolution broke out, Lalande, who was exceedingly anxious for the preservation of these papers, made an attempt to get them into his possession; but his exertions were fruitless. He could only learn, that Le Monnier had concealed them under the roof of his house. When Le Monnier was attacked by the first fit of the apoplexy on the 10th of November, Lalande was therefore afraid that, as no one but himself knew where these papers were hid, the old man, through mental debility, might forget where he had placed them. Le Monnier left three daughters, all married; the second of whom was married to the celebrated mathematician La Grange on the 31st of May 1792.

INTELLIGENCE,

AND

MISCELLANEOUS ARTICLES.

ROYAL SOCIETY OF LONDON.

THE reading of Dr. Hulm's interesting paper on the spontaneous emission of light by various bodies, was concluded at the meeting of the 27th of February.

An ingenious paper on refraction, by Dr. Woolaston, was read on the 27th of February and 6th of March.

At the latter and the subsequent meeting on the 13th, a paper, by Mr. Henry, of Manchester, on attempts to decompose the muriatic acid, was read. The experiment was made by means of the electric spark on the acid in its gaseous form, but without success. Mr. Henry is of opinion, that the result looked for will never be obtained by means of single elective attraction; and that, if ever a knowledge of the

the baſe of this acid be got at, it muſt be by means of the moſt complicated affinities.

A paper, by Mr. Howard, on his newly diſcovered fulminating oxyd of mercury, of the powerful effects of which we have already taken ſome notice, was read on the 13th and 20th. The proceſs for preparing it we cannot yet fully deſcribe, but it conſiſts in digeſting nitrat of mercury in alkohol. A precipitate is thrown down, which, on being carefully waſhed, to free it from the nitrous acid, poſſeſſes the fulminating property formerly noticed. Experiments with this ſubſtance ſhould be carefully conducted, and in very ſmall quantities, to prevent accidents.

FRENCH NATIONAL INSTITUTE.

In the public ſitting of the 15th Nivoſe, year 8, January 5, the following account of the labours of the Phyſical and Mathematical Claſs during the preceding three months was read by C. Cuvier.

C. Guyton has preſented a table of the direct combinations of forty-two chemical elements; that is to ſay, of ſubſtances which the chemiſts have never been able to decompoſe, and which they muſt conſider as ſimple till proofs of the contrary are obtained. Theſe forty-two ſubſtances, combined only two by two, give 861 different combinations, with the half of which we are not yet acquainted. Combining them three by three, and four by four, paying attention to the proportions of the conſtituent parts of each combination, the number of the latter increaſes in ſuch a manner as to excite aſtoniſhment. One might be inclined to conſider our ignorance reſpecting the greater part of theſe combinations as a proof of the imperfection of ſcience; but ſo far is this from being the caſe, that it is by the immenſe progreſs ſcience has lately made that we are enabled to know that theſe combinations are poſſible.

Among the ſubſtances with which modern chemiſtry has been lately enriched are in particular ſome ſemi-metals, one of which, by its diſcoverer, Profeſſor Klaproth of Berlin, has been called Uranite, from the planet Uranus of Herſchel, as the common metals received from the alchemiſts the names

names of the seven old planets. C. Champeaux, *ingénieur des mines*, is the first who discovered Uranite in France. The details of this discovery have been communicated to us by C. Lelievre.

Chemists have given the name of affinity to that power by which different substances tend to unite with each other, and which properly forms the object of all their researches; for chemistry will never be complete until we obtain a table of the degrees of affinity of each substance for all the rest under given circumstances. What renders it difficult to form such a table is, that these affinities do not preserve the same order in all circumstances. It has been long known, for example, that this order varies according to the degrees of heat; but several other causes, to which chemists have not hitherto paid sufficient attention, concur also to render it uncertain. C. Berthollet has been employed on this part of chemistry, and has presented on that subject a work of great labour, a portion of which he communicated to the Institute of Egypt, and which proves, that in going to search for new facts in a distant country, he has been the occasion of making new progress in the theory which ought to unite them.

Among the causes which change the order of affinities is, the respective quantities of each of the substances brought into contact. One substance, which would exercise no action if it entered the mixture in a quantity equal to the others, exercises a very perceptible action when its quantity is considerably augmented: it seems, then, that the different parts of each substance unite their efforts to overcome the resistance opposed to them.

Another of these causes is, the greater or less cohesion of one of the substances or mixtures. It augments the resistance to the change which the affinities ought to produce.

A third cause is elasticity, which lessens the tendency to combination. Thus any substance, oxygen for example, acts with a far greater force when concentrated in a liquid combination than when it is under the elastic form. The action of heat seems to enter into this third cause. It may be possible that it does not alter the affinity of the different substances but by producing changes in their respective elasticities:

cities: if two or more ſubſtances, then, which enter into any mixture, are of ſuch a nature as to produce an elaſtic, concrete, or even inſoluble compound, we muſt no longer calculate their effect in the definitive reſult according to the abſolute affinity belonging to each, but muſt deduct what this concrete or elaſtic ſtate takes from the affinity. It may readily be perceived what light the application of theſe principles, which have never been before conſidered in their general extent, muſt throw upon all the phenomena of chemiſtry.

C. Berthollet, by means of theſe principles, has been able to bring under the common laws of chemiſtry a multitude of facts which ſeemed inſulated, or even contrary to theſe laws. Hitherto, for example, the affinities of the greater part of theſe compound bodies were conſidered independently of thoſe of their compounds, becauſe the circumſtances above mentioned were not taken into account. C. Berthollet clearly ſhows that in many caſes they depend on each other; and how, from ſo ſmall a number of elementary ſubſtances, when chemically conſidered, ſo many compounds, and effects ſo various as thoſe exhibited by Nature, can be produced.

Beſides the table before mentioned, C. Guyton has preſented to us four others, deſtined, like the firſt, for the inſtruction of the pupils in the Polytechnic School. One of them contains a methodical diſtribution of minerals into orders, claſſes, genera, and ſpecies. Another gives a complete ſyſtem of the external character of minerals according to the principles of Verner, with additions. The object of the third and fourth is, to facilitate to beginners Haüy's theory of the ſtructure of cryſtals, by preſenting in a ſeries the firſt molecule of a cryſtal, its nucleus, and the different modifications produced by the laws of decrement, and by giving, according to the graphic method, a key to the formulæ which repreſent theſe modifications, and the ſolids reſulting from them, without loſing ſight of the nucleus.

Some of the naturaliſts of the Claſs have employed themſelves, during the laſt quarter, on the remains of organiſed bodies diſcovered in places where living animals analogous to them do not at preſent exiſt.

C. Villars,

C. Villars, aſſociate, has announced to us that he found foſſil wood in the turf on one of the higheſt mountains of the Alps, near a glacier, and at the height of more than 2280 feet above the neareſt foreſts now in exiſtence. This foſſil wood conſiſts of trunks of larch, birch, and mountain-aſh, with their roots in perfect preſervation. Their ſituation gives C. Villars reaſon to believe that they grew on the ſame ſpots where they are buried. But how has the cold become ſo violent that the ſame trees can no longer live at ſuch a great altitude? C. Villars aſſigns the cauſe to the ſinking down of the ſummits of theſe mountains; their waſting in conſequence of being waſhed away by the rains; and the imprudent deſtruction of wood by the hand of man.

A fact no leſs curious has been communicated to us by Poiret. He has found freſh-water ſhells in ſtrata of turf, and covered by other ſtrata of the ſame turf containing marine ſhells. The ſoil which preſented theſe objects muſt then have been firſt watered by rivers, and afterwards inundated by the ſea, though at preſent it is found in the middle o. the Continent.

C. Beavois, aſſociate, has brought us, from North America, proofs of changes no leſs aſtoniſhing in the ſtate of the earth. The remains of enormous quadrupeds, abſolutely unknown at preſent, have been found there at various periods; but C. Beavois has ſhown us bones different from any hitherto dug up. Each day, and every climate, furniſhes proofs o1 the revolutions which our globe has experienced, and which are imprinted on its ſurface and in its bowels in indelible characters.

In Botany, the Claſs has received from C. Brouſſonet valuable obſervations on ſuch plants in Morocco and the Canary iſles as are either uſeful or new. In theſe iſlands the inhabitants cultivate the *meſembryanthemum cryſtallinum*, from which they extract ſoda, and which by combuſtion gives a third of its weight. C. Brouſſonet is of opinion, that this plant might be cultivated in the department of Var, between Montpellier and the ſea.

C. Teſſier has communicated obſervations on a diſeaſe in

millet, which he calls *charring* (the fmut). It is propagated by communication, and may diminifh the crop one-half.

C. Desfontaines prefented the fecond and laft volume of his Flora of Mount Atlas. This work, which, on account of the correctnefs of the defcriptions and the beauty of the plates, may be ranked with any thing of the kind ever yet publifhed, is a ftriking proof of the zeal of its author, who collected the materials in the deferts of Africa, where he was every moment expofed to new dangers.

C. Ventenat has communicated a very extenfive work on the lime-tree. He has defcribed feven fpecies unknown to Linnæus, feveral of which might be naturalifed in our gardens; and particularly one, which, no doubt, would be preferred to the common lime on account of its leaves, which being thicker, refift better the heat of fummer; and of its flowers, which are fweeter and laft much longer.

Our anatomifts have been employed chiefly in unfolding the organifation of two animals of the fimpleft kind and the moft diftant from man. One of them, named the *medufa*, is found in the waters of the fea, where it is nourifhed not by one mouth, as all the other known animals, but by a multitude of fmall tubes, which may be compared to roots. Its ftomach fupplies the place of a heart, and conveys the nutritive juice, through ramified veffels, to every part of the body.

The fecond, to which C. Huzzard has called the attention of the Clafs, is found in the interior part of the brain of fheep, and never any where elfe, though it is difficult to conceive why this fhould invariably be the cafe. This animal occafions a mortal malady, the fymptoms of which are, that the fheep affected jump and run round with a fort of convulfive movement. The body of this animal forms a veficle filled with water: on one body there are feveral heads, and each head has a mouth. A fpecial commiffion has been appointed to endeavour to find out the beft means for deftroying this fingular infect.

C. Chaptal has made known to us a new method for bleaching cotton.

C. Loifel,

C. Loisel, associate, has published a complete treatise on all the processes in regard to the art of glass-making.

C. Sabbatier has shown, that it is often possible to save those who have the upper part of the arm shattered, or the head and neck of the humerus attacked with caries or exostosis, from the cruel and dangerous operation of amputating that limb at the joint, that is to say, at the place where it is joined to the shoulder, merely by extirpating the upper part of the bone. Several persons treated according to this method have experienced no sensible decrease in their strength or the mobility of the arm.

GASEOUS OXYD OF AZOT.

We have already had occasion to mention the result of some experiments made at the Medical Pneumatic Institution, Bristol, with this new gas, and the hopes these afforded that it would prove a powerful remedy for various diseases. The following extract of a letter, with which we have been favoured from Dr. Beddoes, gives some farther information on this subject, that cannot fail to prove interesting to our philosophical readers:—

" SIR,

" I am sure it will give you pleasure to hear that the gas which you noticed in your Magazine has fully maintained its character. The inference I could not fail to draw from the first effects, with regard to its power in curing palsy, has turned out just. You will undoubtedly believe that I do not mean to affirm that it will prove an infallible remedy in paralytic complaints; but in the most inveterate cases of hemiplegia, originating in apoplectic seizures and confirmed by repeated strokes, it has restored feeling and the power of voluntary motion to the affected side; and I am persuaded it will continue to do as much in a large proportion of instances. The full details will be given in a work by Mr. Davy and myself, now in the press. No untoward accident has occurred in the many hundred trials lately made with the gas: but a few hysterical females having cautiously respired it, there has been reason to think that a larger dose would have given rise to fits, as stated in my *Notice*."

We

We may take the present opportunity to mention, that we understand Dr. Beddoes means soon to give *Lectures on the Laws of Animal Nature, and on the Means of preserving the System from Injury upon the most important Occasions of common Life.*

"A popular exposition of the principles of the animal economy, with their application to the purposes of individual and domestic welfare, upon a plan widely different from that of any existing publication, has long been seen necessary by many people.

"Heretofore an acquaintance with the causes of his personal condition has seldom been numbered among the *accomplishments* of the scholar, or the *qualifications* with which the man of business is fitted out for success in the world: yet it will be confessed, that neither success in business, nor proficiency in the sciences accounted *liberal*, are separately sufficient for rendering the condition of human life desirable; and, in fact, to endeavour, by any combination of these materials, to construct a system of personal happiness, is to project an edifice which shall stand secure without a foundation. Of a truth, so long and so generally neglected, a portion of the public, it is believed, begins to feel that degree of conviction which operates upon conduct. In this belief, the present opportunity of instruction is offered to those who may be desirous of it.

"Numbers fall victims to their own impatience under illness, or to the wavering conduct of their friends. Frequently on the onset of dangerous diseases, people, by suffering themselves to be amused by trifling domestic expedients, lose an opportunity which no medical skill can ever retrieve. Upon these evils the prevalence of juster ideas would act as a check. Nor is it paradoxical to suppose that the mortality among infants would be smaller, and debility of constitution at all periods of life more rare, if parents (however instructed in other things) were not in common nearly upon a level with nurses in that which it so much imports them to possess—an acquaintance with the powers that operate to the injury or advantage, the destruction or preservation, of the objects of their affection."

The

The Lectures are to be calculated for both ſexes and different ages; and that there may be little chance of excluſion by reaſon of narrow circumſtances, the ſubſcription is fixed at One Guinea; but, unleſs fifty perſons ſhall have entered their names by the 31ſt of March, the Lectures will not go on, as, without a tolerably numerous audience, Dr. Beddoes thinks he could beſtow his time in a manner more advantageous to the public.

We ſincerely hope nothing will prevent this uſeful deſign from being carried into effect.

COW POCK.

Extract of a Letter from Dr. De Carro of Vienna, to Dr. Pearſon.

"DEAR SIR,

"Two Hanoverian gentlemen, Dr. Ballhorn and Mr. Stromeyer, who, as you know, are making experiments with cow-pock, and with whom I correſpond, informed me that this diſeaſe is very well known in Holſtein, and that a certain Dr. Neſſen, of Siegeberg, has collected many facts which prove its anti-variolous property. Being myſelf lately in company with ſeveral Engliſh gentlemen, who were putting to me many queſtions on the ſubject of cow-pock, an American gentleman, Mr. Murray, of Philadelphia, told me that his ſervant, a German, had lived three years in the Duchy of Holſtein, and that he thought he recollected that he had mentioned to him ſome facts which coincided much with what I was telling them about the cow-pock. This gave me the curioſity of ſpeaking to that ſervant, who, he told me, was very intelligent, and had ſhown often a ſpirit of obſervation. Here is the ſummary of his anſwer:—That during a ſtay of three years in Holſtein, in the environs of Kiel, he had very often heard of a diſeaſe of cows called *Die Finnen*, (*finne* means, in general, a pimple, *un bouton*; *finnig*, pimpled, *boutonné*,) and that he had had frequent occaſion of ſeeing cows affected with that diſeaſe: that its property of preſerving againſt the ſmall-pox is well known by the farmers and phyſicians of the country: that, in the town of Kiel, the inoculation with the *finnen* is ſometimes practiſed upon chil-

 dren

dren in the idea of preferving their beauty: that the country-people do not like this inoculation, becaufe they pretend that it leaves behind it feveral other diforders: that, waiting at table, he had very often heard gentlemen, and among others a Dr. Ackermann, fpeak of its anti-variolous power: that in great farms men do not milk cows, but that in the fmaller ones that happens very often: that a difeafe of horfes called *mauke* (true German name for *greafe*) is known by all thofe who take care of them: that old horfes particularly, attacked with the mauke, are always put in cows' ftables, and there are attended by women: that it is particularly in harveft that men in fmall farms milk cows: that he never heard of any relation exifting between the *finnen* and the *mauke*. He defcribes that difeafe of cows like a pimple between flefh and fkin (that is his expreffion); and fays, that when a cow is affected with it, fhe lofes her milk and becomes very lean: that farmers kill the fick ones to prevent the contagion: that they fometimes falt thofe cows, and give them in winter to eat to their fervants, who diflike the flefh fo much that they look upon this treatment as a mark of avaricioufnefs: and that the puftule produced by inoculation is about the fize of a pea, and is never attended with any other eruption."

HEAT AND LIGHT.

Dr. Herfchel, whofe difcoveries have already tended fo much to the increafe of fcience, has, we underftand, made a difcovery within thefe few days paft that bids fair to place his name higher than all the refearches he has yet made—he has found out a method of feparating the rays of heat from the rays of light.

ECONOMY IN COOKING.

Into a digefter ufed by the Soup Committee of Manchefter was lately put a large bone of beef, from which all the meat was carefully cut and fcraped away, and which weighed when put therein $25\frac{1}{2}$ ounces, and when taken out again only 10; fo that there was gained of good and wholefome food $15\frac{1}{2}$ ounces, or full three parts in five of what is ufually loft in the economy of it.

THE

PHILOSOPHICAL MAGAZINE.

APRIL 1800.

I. *Description of the Island of Borneo, with some Account of the Manners and Customs of its Inhabitants.* By Mr. VON WURMB *.

THE Portuguese, Dutch, and English, ever since the sixteenth century, have in turns endeavoured to establish themselves in this island, which is one of the largest in the Indian ocean; but the Dutch alone, by being so fortunate as to have a preponderance in India, were able to accomplish their object. On account of the gold and diamonds found here, as well as of the pepper, of which the Dutch East India company export annually 600,000 pounds, this island is of considerable importance to their trade.

It is reported that, when the Portuguese wished to form a settlement here in the year 1526, they presented to the sultan of Landac and Succatana some beautiful pieces of tapestry on which figures of various kinds were represented; but that the sultan, who took these figures to be animated or magic figures, and apprehended that they might unexpectedly rush from the tapestry and strangle him, rejected the present, and expelled the Portuguese, with their presents, from the country. The English were not much more fortunate, having quitted Borneo entirely ever since the year 1706. In 1766

* From *Merkwürdigkeiten aus Ostindien,* published by the author's brother.

they made an attempt to form a settlement in the island of Balambangan, at the northern extremity of Borneo, which was given up to them by the king of Solon. They had in it a few Europeans for the sake of trade; and a garrison of three hundred soldiers, Europeans and blacks. Their view was to establish here a factory, where they might exchange the productions of Europe and Hindostan for those brought hither from China and the Indian islands; but in the year 1772, after a part of their troops had been swept off by contagious diseases, the fort they had constructed, being badly fortified, was suddenly attacked, and the whole establishment destroyed. The English are still ignorant who were the authors of this violence; and they do not know whether they ought to ascribe it to the Dutch, jealous of their trade in that neighbourhood, or to the Spaniards, afraid of their possessions in the Philippines.

Various accounts of Borneo may be found in the works of different authors; such as Valentyn's General Description of India, Salmon's Present State of all Nations, the General History of Voyages by Prevost, and the paltry compilation of the abbé de la Porte. But as this large island is as yet little known even in India, and as no European has been able to penetrate to the interior part of it, all these descriptions are erroneous and imperfect. That I may therefore give the public the latest and most authentic information respecting this island, I shall confine myself chiefly to the account of it published in the Transactions of the Society for promoting the Sciences at Batavia, in the island of Java. The island of Borneo extends from the fourth degree of southern latitude to the eighth of northern, and from the hundred and fiftieth to the hundred and fifty-eighth of longitude. It is about 780 miles in length and 720 in breadth. Its climate is almost the same as that of Java; but Borneo is less mountainous, and the land, for twelve or fifteen miles, and sometimes more, from the coast, is almost every where marshy. The remaining part of the island is sufficiently fertile, and would be productive were not the natives too indolent to cultivate the soil, and fonder of searching for gold and diamonds, which they barter with the Javanese

vanese for various necessaries of life. The middle of the island is occupied by an extensive ridge of mountains called the Crystal Mountains, because a great quantity of crystal is found in them. At the bottom of these mountains is a large inland lake, which gives rise to all the rivers that traverse the whole island.

The real natives of this island are the Biadjoos or Dajakkese, who live in the interior parts of the country. The sea-coast is inhabited by a mixture of Malays, Javanese, and Macassars. It is only of the countries situated on the coast that we have any certain accounts, for the interior parts of the island are as yet very little known.

The greatest kingdom in the island, and the most important on account of its connection with the Dutch East India company, is that of Banjermassing on the southern side. The great river Pontiana, which is navigable for ships that draw from twelve to thirteen feet of water, is exceedingly convenient for trade. The sultan Susuhunan Natahalam, since the year 1771, has transferred his residence from Cagu-Tangie to Martapura, where he caused a large city to be built, and a canal to be dug which passes through the middle of it; at the same time the name Martapura was changed into Bumie-Kintjana. The reader may from this readily conceive that the power of this sultan is not inconsiderable. The inhabitants of the city, as well as those who reside in places at a distance from the coast, are mahometans, mixed with a great many Biadjoos or Dajakkese, who are pagans. These Biadjoos, who inhabit a great many villages, the number of which is said to amount to 784, are subject to various petty princes, who acknowledge the sultan as their superior. Of these Biadjoos, who are the original natives of the island, I shall speak hereafter.

The factory of the Dutch East India company is situated at the end of the village of Tatas, or Banjermassing. It consists of an octagonal fort surrounded by palisades, which on the east side next the river is furnished with three, and on the west, or land side, with two bastions. The productions of the country sought for as articles of commerce, are pepper, gold, (mostly gold-dust, not very abundant in metal,) dia-

monds, canes, birds-nests, wax, pedra del porco, dragons-blood, and iron. For these the Dutch give in exchange, agates of a longish form, rings of red agate, different kinds of coral; all sorts of Chinese articles, such as coarse porcelain, red and other kinds of silk; all sorts of cotton cloth, clothing such as is worn by the Indians, various productions of Java, and also opium: but the last must be introduced privately, as the use of it has been strictly prohibited by the sultan.

Succatana lies in 0° 50′ south latitude. A little further north is the river Pontiana, which, through a great many mouths, discharges itself into the sea under the line. This river at its mouth is twelve feet in depth, and at high water sixteen, so that sloops and small vessels can proceed to the company's factory with great ease. The passage from the mouth of the river to the factory requires twelve hours. At the distance of seven or eight miles from its mouth, the river divides itself into two branches; the southernmost of which flows through the country governed by Pangerang Josep, who in 1778 was raised by the East India company to be sultan of Sasango and Pontiana, under the name of Sarief Abdulla Rachmann. These two kingdoms extend a great way into the country. One of the servants of the company saw at the court of this sultan, one of his vassals, the king of Gascaro, whose dominions lay at the distance of upwards of a hundred miles; and he was told that in that country there had been found some pillars, three feet in height and three in breadth, inscribed with European characters. If this information be correct, the Europeans at some early period must have penetrated a considerable way into the interior parts of the island. The Society of the Arts and Sciences at Batavia had hopes of obtaining a copy of these inscriptions, by which means the mystery might have been explained; but hitherto they have been disappointed.

Pontiana and Sasango produce excellent gold, wax, birds-nests, pearls, sago, diamonds, tin, and iron, which are bartered for provisions of all kinds and cotton cloth, but particularly rice and salt. Heavy rains, accompanied with thick clouds, prevail here from the month of November till May.

It

It deserves to be mentioned, as a meteorological observation, that the thermometer here is never lower than 82°, and never higher than 94°.

Landac lies on the northern arm of the river Pontiana, about seventeen miles higher up, in the latitude of 0° 35′ north. The Dutch had a resident here so early as a hundred and fifty years ago. After that period their possessions were destroyed, till the king of Bantam, to whom Landac and Succatana had for many years belonged, made a present to the company of all these lands in the year 1778—but whether voluntarily or through compulsion I cannot venture to say. This much, however, is certain, that the Dutch after that time considered these lands as their property, and the princes who govern in them as their vassals; built their fort at Pontiana, between Landac and Succatana, and appointed Pangerang Saidja Nata as regent of the whole district.

The residence of the prince of Landac is situated on the projecting corner of a mountain, to which there is an ascent by 118 steps. Two rivers, which are so full of rocks that no kind of vessel can be navigated in them, flow on the right and left of this mountain; and as there are other mountains on each side of these rivers, this place is so strong by nature that it is impregnable. It is also well furnished with artillery: besides several small cannons, there are in it two iron guns, eight-pounders, one of which has on it the company's arms, and the other the Danish. It is inconceivable how such heavy masses could have been conveyed to the summit of so steep a rock. In this kingdom there are gold and diamond mines of considerable importance.

Between Landac and Borneo, the most northern kingdom of the island, and from which, in all probability, the whole country takes its name, there are several smaller kingdoms, which are not of great importance, but which are not yet sufficiently known. Their regents are, in part, vassals of the sultan of Borneo. A small trade is carried on in these districts with gold, diamonds, canes, wax, and other articles of the like kind, which are given in exchange for the productions of Java; but this traffic is of little consequence, and at

the same time uncertain, because this part of the country is inhabited by several discontented princes who live by piracy.

Borneo is governed by a sultan, who has his residence in this place, where a considerable trade is carried on with the productions of the country, which are pearls, birds-nests, wax, slaves, rice, and camphor. The camphor of this island is considered as the best, and is preferred even to that of Sumatra. Houtynn, a physician of Amsterdam, to whom natural history is so much indebted, and who, in the Transactions of the Society of Haarlem *, has given a description with figures of the camphor-tree from the dried branches, transmitted to him by a member of the Society of the Arts and Sciences at Batavia, says: " The camphor of Borneo and Sumatra is produced by a tree with oval, sharp-pointed leaves and large tulip-like flowers. By these marks it is distinguished both from the camphor-tree of Japan, and from the other species of the laurel. A hundred weight of the camphor of Borneo costs 3000, and one of that of Sumatra 2000 rix-dollars, but the Japanese costs scarcely fifty: the last, however, is much more volatile than the other kinds." Of the camphor of Borneo about 4375 pounds are exported every year. The articles imported are tin, cotton cloth, and all the productions of Java except rice, which is cultivated here in great abundance.

The sultan of Borneo lives in great state, and is more feared by his subjects than that of Banjer; but at the same time, according to the account of some Englishmen who frequent this part of the coast with small vessels, and carry hither cotton cloth, which they exchange for pepper, he is more constant in his friendship and truer to his engagements.

Between Borneo and Tidor lie the two small kingdoms of Balangan and Baraoou, where birds-nests, wax, &c. are exchanged for Javanese productions and a sort of coarse cotton cloth. Next comes Dannuar, which is subject to a Dato called Beginda; and a little further, Sammunta, under Dato Tomongong; and Cottee, which is governed by a sultan named Adgie Umut. Between the two last there are a

* Vol. XXI.

great

great many villages, the names of which are unknown. The same articles are exported and imported here as at Borneo. The next place is Appar Karrang, governed by the sultan Thua; and then Passier, the last kingdom, which belongs to the sultan Annom. The articles of trade in this country are gold, birds-nests, wax, and canes, which are exchanged for the productions of Java. The inhabitants of Passier are very few in number, and therefore it has not been possible for them to drive back the Buginese, who have made themselves masters of the river, and at the same time of the trade.

Further south lies Simpanahan, which is governed by Pangerang* Prabo. The whole country from this place to the extreme boundaries of Salatang belongs to the king of Banjermassing, who possesses also the great and small island of Pulu-Lauts. There appear to be no other kingdoms in the interior part of Borneo; at any rate, if there are, they are not known. The inhabitants of the mountains bring the productions of their lands, and their different articles of manufacture, to the nearest part of the coast for sale.

I shall now lay before the reader what I have been able to learn respecting the Biadjoos or Dajakkese, who for the most part inhabit an extensive district in the interior part of the country on the west side of the river Banjer. The Biadjoos are of large stature and well built. Their women are said to be fair and handsome; but they never bring them to Banjer, or any other of the places where they trade. The dress of the Biadjoos has a great resemblance to that of the Malays. Their women, and even the wives of their princes, go naked to the middle, and in general have nothing around their body but a short gown. The men paint their bodies with figures of various kinds, as is the case among the other natives of the island and throughout all India. They come to Banjer to sell their gold, canes, and rice, for which they receive in exchange coarse Chinese porcelain, copper and earthen vessels, or tampayangs, on which are represented dragons, snakes, and other figures suited to their taste.

Their marriages are accompanied with some very singular

* Pangerang, dato, kiey, radeen, and other terms of the like kind, are words which express different degrees of dignity.

ceremonies.

ceremonies. When a bachelor has conceived an attachment for a young woman, he employs ſome female to aſk her in marriage from her parents; but he is ſure of receiving a denial unleſs he has given a proof of his courage by cutting off the head of an enemy. If his offer is accepted, he carries to his bride a preſent, which conſiſts of a male or female ſlave, two dreſſes, and a water-pot, on which ſome of their favourite figures are repreſented. When the wedding-day arrives, the bride and the bridegroom each give an entertainment at their houſes; at the concluſion of which the bridegroom, in his beſt apparel, is conducted to the reſidence of the bride, where he finds at the door one of her relations, who ſmears over him the blood of a cock which has been killed for that purpoſe; and the ſame ceremony takes place in regard to the bride, with the blood of a hen. They then preſent to each other their bloody hands; but it is conſidered as a bad omen if the blood, in conſequence of this joining of hands, ſpirts out too far around them. The new-married couple then remain together, and the whole ſolemnity ends with a ſecond entertainment. When the wife lies-in, the huſband aſſumes the office of nurſe, and no other care is uſual on this occaſion than that one of their conjurers, whom they call *balian*, gives the newly-delivered woman ſome medicines, amidſt ſinging, and beating on certain inſtruments named *gindang*. If the wife die, the huſband cannot enter again into the married ſtate until he has cut off the head of ſome individual of another nation, and thereby avenged the death of his wife.

When a Biadjoo dies, the body is put into a coffin, and kept in the houſe until all the remaining males of the family, father, ſon, and other near relations, have purchaſed a ſlave; who is to be beheaded on the day when the body is burnt, in order that he may attend the deceaſed in the other world. Before this unfortunate wretch is butchered, it is earneſtly recommended to him to be faithful to his maſter on the other ſide of the grave. The aſhes of the burnt body are afterwards collected in one of the above-deſcribed water-pots, and the pot, together with the head of the ſlave who has been ſtrangled, is depoſited in a ſmall edifice or tomb built for that purpoſe. A year often elapſes before the relations of the

the deceased are in a condition to purchase a slave to serve him in the next world.

Their houses are constructed of boards joined together, and have neither windows nor partitions except that which separates a small corner for sleeping in. The whole family reside together along with their slaves, forming in the whole sometimes a hundred persons. They have nothing to afford them light but a thin piece of pine-wood, which burns no longer than till about eight in the evening. Over their doors they suspend the heads which they cut off in their skirmishes, and often while they are still bloody. Whenever they conceive a desire of displaying their courage by cutting off heads, they set out on an expedition for that purpose. On such occasions, the person who wishes to gratify his bloody intention makes known his design to his friends and relations, who deliberate with him on the means to be pursued, and who accompany him, together with their dependants and slaves. They then proceed, in great secrecy, to the river Banjer, and lie in wait for some small vessel belonging to Banjer fishermen, whom they either surprise in the night-time or attack and carry away in the open day. One or perhaps two of these unfortunate captives are then destined to become a sacrifice to their insatiable rage for murder.

When the Dajakkese bring home a head, the whole village, men, women, and children, testify their satisfaction by every demonstration of joy. People who beat on gongs * are stationed in a row in the street to conduct the conqueror, with the head in his hand, to his own house, where he is received by all the women present, who dance around him. When he approaches the door, he finds where the gongs cease a cushion placed for him, on which he sits down, and where the head is taken from him by the women. The fortunate head-hunter receives presents from all the company, who dance and afterwards partake of a repast. At the same time some food is thrust into the mouth of the head, and a little drink is poured into it; after which it is hung up as a perpetual trophy of victory.

* The gong is a kind of musical instrument of copper.

Thefe people, however, before they undertake expeditions of this kind in queft of Banjerefe heads, always endeavour to deduce fome omen of good or bad fortune from the flight of a kind of hawk *. With this view they entice the bird to perch on the ground, by ftrewing rice on it, and by other means; and if he wheels round when he rifes, and difappears in the clouds, or flies towards that quarter to which they intend to proceed, they confider it as a fign of good fortune, and they fet out with frefh courage: but if the bird directs its flight towards a quarter oppofite to that to which they wifh to go, they defer the expedition till a more favourable opportunity. It often happens that they muft wait two or three days before fuch a feathered prophet appears to inform them when they are to expect good fortune.

The Biadjoos have fcarcely any form of government, and no written laws. If a perfon is accufed of theft, and if fufficient proof cannot be adduced againft him, the culprit and the accufer are carried before one of the oldeft inhabitants. An earthen pot with afhes and water is placed on the ground, and a bit of wood, on which are depofited two fmall copper buttons, is laid acrofs the pot. After an oath has been adminiftered to each of the parties, the bit of wood is turned round in fuch a manner that the buttons fall into the water; the accufed and the accufer muft then each draw one of the buttons from it, and he whofe button appears as if fcoured, and rendered white by the afhes, gains the procefs.

It is faid that the Biadjoos have fome idea of a Supreme Being, to whom they addrefs prayers under the name of Dewatta; and as they believe that this Dewatta not only created, but ftill preferves and rules the world, they requeft him to grant them happinefs and profperity. Refpecting the notions which they entertain of this deity, and the particular worfhip they pay to him, I can give no further account. If we may judge from the character of thefe people, their deity muft be a gloomy and revengeful being: no nation on the earth have a greater propenfity to murder and revenge.

When a married woman commits adultery, and is dif-

* Falco Milvus.

covered

covered by her husband, the latter never makes any attempt against the adulterer, but contents himself with putting to death two or three of his slaves; after which he imagines himself freed from all shame. The woman, on the other hand, is punished merely with words, but sometimes with blows. Do not a people, whose conduct is regulated by such laws, deserve pity? Revenge, superstition, avarice, and a spirit of plundering, are often among civilised as well as uncivilised nations the strongest incitements to acts of cruelty and murder: but the Biadjoo, who attacks only poor defenceless beings, and carries about their heads as trophies of his courage; who never attacks his enemy himself, but endeavours to be avenged by putting to death innocent slaves, certainly surpasses in cruelty the ravenous animal that devours others only to appease its hunger. Let us hope, for the honour of humanity, that a good deal in this imperfect relation may be exaggerated.

The Biadjoos are unacquainted with polygamy. When a man wishes to separate from his wife in consequence of her having been guilty of some crime, he retains her clothes and ornaments, and causes her to pay besides a fine amounting to about thirty rials. After this, each party may again marry. These people acknowledge the sultan of Banjer as their sovereign, and pay him yearly a small tribute in gold dust of the value of twenty rials.

The principal part of our information respecting these people was obtained from a Mr. Palm, who made a journey from Pontiana to Landac in the year 1779 on business of the Dutch East India company, and who, on this occasion, penetrated a considerable way into the country. At Landac he paid a visit to the gold and diamond mines, and on his return had the good fortune to get into his possession an orang outang of the largest kind, which is properly a native of this island. As this animal has been described in the Transactions of the Society for promoting the Arts and Sciences at Batavia, I shall say nothing further of it *, and

* For a description of this animal from the above Transactions, see the Philosophical Magazine, Vol. I. p. 225.

proceed to give the reader some account of the diamond and gold mines.

In working the diamond mines great care is required to examine the ground intended to be dug. The places where diamonds are to be found may be known by certain small flints, generally of a black colour, which lie on the surface, and also by the yellow colour of the stony soil. The surest method, however, is to follow the directions of the people who reside in the neighbourhood of these mines, and to whom superstition ascribes the same wonderful power as the so called divining-rod of the Europeans was supposed to possess formerly. It is said that at certain periods of the day, such as four o'clock in the morning, twelve at noon, and four in the afternoon, they have the faculty of seeing the reflection or shining of the diamonds through the earth. These mountaineers point out to the diamond-miners a certain spot where they ought to dig; but they receive no payment till it actually appears that it contains diamonds. A pit about six feet square is then made in the place with a kind of pick-axe, for in such stony ground shovels and spades cannot be employed. The earth when loosened is taken up in baskets, formed into heaps, and afterwards sifted by people, who sit in water-pits dug for the purpose, first with coarse and then with finer sieves. The remaining sand is then washen with the water, amidst which the labourers sit and examine it once more. If nothing is found, the stones and earth are thrown on one side; but if any diamonds appear, the overseer, who is always present, watches with great care till the good stones are collected and formed into a heap. The workmen receive but very moderate pay for their labour. All those stones that weigh above five carats must be immediately delivered to the sovereign prince or the sultan. But this law is made only for the simple, as nothing is easier than to swallow such stones, and in that manner to carry them away.

The mines are dug, in a perpendicular direction, sometimes to the depth of ten fathoms. The labourers, however, are totally unacquainted with the art of mining, and therefore when the least difficulty occurs they are entirely at a loss. The sides of the pits are prevented from falling in by bundles

bundles of rice-ſtraw and pieces of wood placed in a croſs direction; but ſuch accidents often happen, particularly in the time of violent ſtorms. As they are incapable of freeing the pits from water during heavy rains, they are prevented from working, and muſt ſuſpend their labour till the weather becomes dry. The moſt productive diamond mines are at Ambauwang, beyond Molucco, in the diſtrict of Banjermaſſing, and at Landac and Pontiana. Beſides theſe mines, which lie among the mountains, diamonds are ſought for alſo on the banks of various rivers; but thoſe who follow this occupation have ſo little ſucceſs, that ten or twelve men will dig and ſearch ſometimes a whole month before they find diamonds to the value of twenty Spaniſh rials.

In regard to the gold mines, the ignorance of the natives reſpecting every thing that relates to mining is ſo great, that little advantage is derived from them, though they are ſuppoſed to be very rich. In Banjermaſſing the gold is found at the depth of about three fathoms; the veins properly ſo called are of a reddiſh kind of marl. At Landac the ore is found at the depth of about ten feet, and the workmen muſt dig till they come to a cruſt which has almoſt the appearance of rotten wood. Until this vein, which is called the covering of the mine, be found, there are no hopes of meeting with gold.

II. *Method of preſerving Birds and ſmall Quadrupeds by means of Ether. By* C. Chaptal.

THIS method of preparing all kinds of animals for cabinets is exceedingly ſimple, and ſo certain in its effect that C. Chaptal never found it to fail in a ſingle inſtance. It is as follows:—The matter contained in the bowels of the animal muſt be evacuated, either by gradually preſſing the body towards the rectum, or by injecting ſome liquid which may remove every thing that ſtands in its way. After this operation, the end of the rectum is to be tied with a thread, and ether to be injected, with a proper inſtrument, into the body through

through the mouth or bill; and when the bowels have been filled with it, the animal is to be hung up by the head. One of the eyes muſt then be ſcooped out, and the brain extracted: after which the head is alſo filled with ether, which muſt be prevented from eſcaping by plugging up the eye-hole. On the ſecond or third day the injecting of ether is to be repeated, and this proceſs is to be continued till the animal be completely dried.

While the animal is gradually drying, care muſt be taken to give to the body its proper poſition, and as ſoon as it is completely deſiccated it may be put up without further care or any other preparation. A ſmall female papajay, prepared according to this method in the year 1782, was loſt behind the ſhelves of a library, and remained there two years without its ſolidity or form being in the leaſt changed. This proceſs for preſerving animals ſeems to be attended with conſiderable advantages. C. Fouchy, of Montpellier, ſays C. Chaptal, who has made ornithology his particular ſtudy, recommended ſpirit of wine, a few years ago, for the ſame purpoſe; but as ſoon as the ſpirit of this liquid has evaporated, the remaining aqueous part promotes corruption in a very great degree; whereas ether, by its evaporation, carries with it not only its own aqueous particles, but thoſe alſo which it abſorbs from the body. Beſides, this method neither deſtroys the form of the animal nor tarniſhes the ſplendour of the feathers or hair, and is exceedingly cheap: one ounce of ether is in general ſufficient for a ſmall bird. A large papajay required only one ounce and a half. As the proceſs is attended with ſo little expence, it may be uſed for animals of a conſiderable ſize.

C. Chaptal remarks, that in regard to animals which have been wounded, and on that account have apertures in their bodies which cannot be ſhut ſo well as the natural apertures, the proceſs is more difficult, and attended with greater trouble, as they are leſs capable of containing the ether. Such animals, therefore, muſt be choſen for preſervation as have died a natural death, or as have been killed by being ſtrangled. The proceſs will be performed ſooner or more ſlowly according

ing as the weather is more or lefs favourable for drying the body. The procefs of drying might perhaps be a little fhortened by the application of artificial heat.

The theory of this procefs, as C. Chaptal thinks, is, that the ether, while it evaporates, volatilifes the moifture in the animal body, by thefe means effects a gradual deficcation, and thus removes the only caufe of corruption.

III. *Defcription of a new Inftrument for Trepanning, invented by Mr.* JOHN RODMAN, *Surgeon in Paifley. Communicated by the Inventor.*

THE operation of trepanning muft be confidered a very important one in furgery, both on account of the dangers with which it is often attended, and the beneficial effects which follow the fuccefsful performance of it. The danger and accidents which attend this operation arife partly from the imperfection of the inftruments employed, and partly from want of dexterity in the operator.

To manage the inftruments now in ufe for trepanning with neatnefs and facility, would require a degree of mechanical dexterity which falls to the lot of few furgeons: yet furgeons the moft inexperienced, and unaccuftomed to operations of any kind, are often neceffarily called upon to perform this operation.

The trepan is allowed by the greater number of furgeons to be a dangerous inftrument, and the ufe of the trephine, though more generally employed, has been fometimes followed by fatal accidents.

The chief objection to the more general ufe of the trepan feems to arife from the chance of its paffing fuddenly in upon the brain towards the end of the operation. To avoid fuch an accident, the celebrated profeffor of anatomy at Edinburgh fays, in his lectures, that it might be as well to begin the operation with the trepan, and to finifh it with the trephine. But, whichever of thefe inftruments be employed, there is ftill a rifk of the bone being unequally cut: for, if the inftrument be held in the fmalleft degree to one fide during the operation,

tion, the bone at that side to which it is most inclined will soonest give way, and consequently the brain may be injured before the surgeon is apprised of it. Such accidents, it is well known, have frequently happened. Sometimes, too, the centre-pin, from agitation or inattention of the surgeon, has been left in the instrument to the end of the operation, and, after passing through the bone, has perforated the brain.

Besides these, and several other obvious objections, the number of necessary auxiliary instruments sufficiently evinces the propriety of attempting to simplify and improve the present mode of operating.

The manner of perforating the skull by the instruments now in use is, first, with the perforator, to make a small hole in the bone of a sufficient depth to receive the centre-pin of the saw, then to apply the instrument, and to continue sawing till the groove is deep enough to preserve the instrument steadily without the centre-pin: the instrument then is withdrawn, and the pin removed by means of the key. The surgeon now proceeds to finish the operation, and, having replaced the instrument, works through the bone with the greatest caution, taking care to withdraw and replace the instrument from time to time, in order not only to clear away the dust that fills up the teeth of the saw, but to discover whether the portion of bone to be removed is nearly separated.

By this way of operating it is evident a considerable portion of the time is taken up even in preparing for the operation, beside what is lost during the course of it. To save time in this, as in every other operation, must be considered as a matter of great consequence both to the patient and surgeon. With a view to show how this may be accomplished, it will be necessary to mention in what manner the operation may be conducted with the instrument now to be proposed.

The patient being prepared for the operation, and the instrument applied, as in the plate, care must be taken to make the sawing-teeth round the whole circumference touch the surface of the bone equally. This can easily be done; for, though the inequality of the bones on which the instrument is placed be such as to prevent the saw from acting on all

points

points of the circle alike, one or other of the legs may be lengthened or shortened at pleasure, by means of the setting screws; and in this manner it may be made to fit exactly.

The next step of the operation is, to cut the pericranium with one or two turns of the instrument, and, if necessary, that portion of the membrane within the circle of the saw may be removed with the fingers. The sawing is now begun by turning the handle with one hand, and holding the instrument firmly with the other. Thus the bone may be cut very quickly; and if the surgeon wish to proceed cautiously towards the end of the operation, he may then work the instrument in the manner of the trephine, which can be done by grasping the handle with one hand, and supporting the frame as before mentioned.

The simplicity of the instrument, and the mode of operating with it, will be better understood by the following description:

A, A, the handle, (Plate VII;) B, B, the axle, passing through D, the upper part of the frame; and C, the cross-band. E, E, E, the sides of the frame; F, F, F, the feet or rests, which slide in the sides of the frame K, K, K, and are fastened with thumb-screws *b, b*; G, the cutting-head, fixed on the end of the axle; H, a collar which slides upon the axle, and can be made fast upon it with the thumb-screw *a*.

The sliding-collar may be used with advantage when the surgeon is afraid of plunging the head of the instrument into the brain during the operation; for, by fixing it at a certain distance above the cross-band, it will rest upon it, sooner or later, according to the intention of the operator, and prevent the instrument from passing deeper until the collar be shifted. For this reason, as well as the superiority of the instrument in general to those in common use, it is particularly recommended to surgeons who may have frequent occasion to perform this operation on board a ship at sea.

 IV. *Ob-*

IV. *Observations on the Economical Use of the Ranunculus aquatilis; with Introductory Remarks on the acrimonious and poisonous Quality of some of the English Species of that Genus.* By RICHARD PULTENEY, *M.D. F.R.S. and L.S.* *

BOTH ancient and modern writers on Botany and the *Materia Medica* agree, pretty uniformly, in attributing to many species of the genus *Ranunculus* a corrosive and poisonous quality. In several it abounds in such a degree as, when applied externally, in a recent state, to excite vesications, and ulceration of the parts, frequently of a malignant and gangrenous nature; and, when taken inwardly, to prove poisonous and fatal, by inducing vomiting, inflammation of the stomach, with the usual consequences of *acrid* poisons. These qualities are particularly manifest in the recent plant, while in its highest vigour before flowering; and more intensely in the germen of the flower itself, and in the petals of some.

The poisonous species, that are indigenous, and common in England, are, the *Ranunculus Flammula*, or Lesser Spearwort; *R. bulbosus*, bulbous-rooted Crowfoot; *R. acris*, upright Crowfoot; *R. sceleratus*, Marsh Crowfoot; *R. arvensis*, Corn Crowfoot; and the *R. aquatilis*, or Water Crowfoot, according to the report of various authors. Of these the *Flammula*, *bulbosus*, and *sceleratus*, are judged to be the most acrimonious.

Before the introduction of *Cantharides*, the acrid *Ranunculi* were, all in their turn, used as vesicatories; and Haller tells us †, the *R. Flammula* is still in use as such in some parts of France. Gilibert assures us ‡ that the *R. bulbosus* vesicates with less pain than the *flies*, and has no effect on the urinary passages,

* From the *Transactions of the Linnæan Society*, Vol. V.

† See the *Enumeratio Stirpium* and *Historia Stirpium Helvetiæ*, in which much satisfactory information is collected respecting the properties of this genus of plants; and for which the author has, with his usual candour and accuracy, quoted all his authorities.

‡ *Plantæ rariores Lithuaniæ*, No. 331.

paſſages. He gives it therefore a decided preference as an epiſpaſtic. Other authors allow theſe qualities in the *Ranunculi,* and that they are quicker than *Cantharides* in their veſicating effect; but ſay, that all theſe advantages are more than balanced by the greater uncertainty of their action on the ſkin, and their frequently leaving ill-conditioned ulcers, of which Murray and other writers have recorded inſtances*. Nevertheleſs, the *Ranunculi* were employed in local ſpaſmodic complaints and in fixed pains, and not unfrequently in cataplaſms to the wriſts in intermitting fevers. *Crowfoot* is known alſo to have been one of the ingredients in Plunket's epithem for cancers.

The acrimony of theſe plants is, however, of ſo volatile a nature, that, even in the moſt virulent, it is wholly diſſipated in drying; ſo that, in the form of hay, they appear to be harmleſs, and nutritive to cattle. It is alſo inſtantly expelled in decoction, probably in all the ſpecies; at leaſt, Murray informs us, that the ſhepherds of Morlachia eat even the *R. ſceleratus,* as a culinary plant, after boiling it: the *R. auricomus,* and, as ſeveral authors aſſure us, the *R. repens,* are ſo deſtitute of acrimony as to be wholly inoffenſive, and even worthy of a place among oleraceous plants.

The *Ranunculi* give out this quality wholly in diſtillation: the water of the *R. ſceleratus,* by the experiments of Tilebein, as recorded in the ſecond volume of the *Chemical Annals,* is acrimonious in an intenſe degree, and, when cold, depoſits cryſtals which are ſcarcely ſoluble in any menſtruum, and are of an inflammable nature †. The diſtilled water of the *R. Flammula,* or Leſſer Spearwort, as we are informed by Dr. Withering, is an emetic more inſtantaneous, and leſs offenſive during its action, than white vitriol; and, as if Nature had furniſhed an antidote to poiſon from among poiſons of its own tribe, is to be preferred in promoting the inſtant expulſion of deleterious ſubſtances from the ſtomach.

In the experiments of the *Pan Suecus,* even in the improved edition by Schreber, after the obſervations and renewed trials of Kalm, Gadd, Bergius, and Laſtbohm, made upon horned cattle, goats, ſheep, horſes, and ſwine, all the

* *Apparat. Medicam.* iii, 87. † Page 313.

fpecies of *Ranunculi*, with which trials were made, except the *R. auricomus*, were rejected by the horned cattle; and it is well known, that while our meadows and paftures are eaten bare of other vegetables, the *R. acris* and *R. bulbofus*, which are but too plentiful, are left untouched: neither do cattle willingly eat the *R. repens*, although it is not wholly rejected by horfes, fheep, and goats.

The *R. Flammula*, according to the above experiments, was eaten only by horfes, to which animal it is there faid to be very grateful; whereas the *R. auricomus*, eaten by all the reft, (except that fwine choofe only the roots,) was rejected by horfes. The *R. fceleratus*, which is fuppofed to be the *Herba Sardonia* of Diofcorides, was touched by goats alone; the *R. bulbofus* only by the latter, though it is well known in England that hogs are fond of the roots. The *R. acris* was eaten by fheep and goats; but the *R. aquatilis* is recorded as the only one rejected by all the five fpecies of animals on which thefe trials were made. It does not appear by either edition of the *Pan Suecus*, that any trials were made with *R. arvenfis*; and though horned cattle and horfes will eat this fpecies greedily, (although not without fubfequent injury,) yet it is known to have been highly deleterious to fheep. A notable inftance of this occurred in Piedmont in the year 1786, where a number of thefe animals died, as it was at firft fuppofed, of an epidemical difeafe; but fubfequent examination difcovered that this deftruction was owing to the *Ranunculus arvenfis*. The hiftory of this accident is circumftantially related in the Memoirs of the Royal Academy of Turin, by M. Brugnon *. The herb grows luxuriantly in Piedmont, and the fheep fed with much eagernefs upon it. The effects here mentioned were not immediate, but progreffive; and M. Brugnon, on further inveftigation, was convinced they were principally owing to the roots of the plant; fince, by experiments purpofely made on dogs, thefe animals were almoft inftantly killed by them. On the diffection of the fheep, all the four concoctive organs were found affected with eryfipelatous and gangrenous fpots;

* Memoires de l'Académie Royale des Sciences, Années 1788—1789, à Turin. 4to. 1790.

but

but more particularly the *abomasum*, which he found much more deeply ulcerated than the others; and the mischief had extended into the smaller intestines.

The avidity with which sheep, horses, and cows, eat the *Ranunculus arvensis*, is, as M. Brugnon justly observes, an exception to the commonly received maxim, that herbivorous animals are, by instinct, led to reject whatever is noxious. We see frequently that hunger will impel our domesticated cattle, especially on being first turned to grass in the spring, to eat almost all vegetables promiscuously. Some of our farmers are aware of the effects of *Crowfoot*, of which the *R. acris* and *R. bulbosus* are so common in our pastures, and by which the mouths of their cattle are frequently inflamed and blistered; and doubtless the effects often extend much further, and sometimes prove fatal. There can be little doubt of the same destructive consequences from other poisonous plants, in cases where the cause is little suspected.

M. Krapf, who instituted a set of experiments wholly confined to this genus of plants *, attributes to the *R. aquatilis* the deleterious qualities belonging to the others; observing, that it will vesicate the skin, but is slower in its operation than the *R. bulbosus* and *R. sceleratus*. Bishop Gunnerus also, in his *Flora Norvegica* †, tells us, that this species is not less noxious to cattle than the *R. sceleratus*; that even the goat, an animal less nice in the selection of its food than the others, leaves it wholly untouched.

It is well known to botanists, that the *Ranunculus aquatilis* of Linnæus comprehends four species of the older writers; and even Haller, and some more modern authors, still keep them separate: among whom, the late professor Sibthorp, in his *Flora Oxoniensis*, enumerates them distinctly, under the names of, 1. *R. heterophyllus*, or *R. aquatilis Ger. em.* 829. *Ray Syn.* 249. 2. *R. aquatilis*, or R. aquatilis omnino tenuifolius *J. B.* iii. 781. *Ray Syn.* 249. 3. *R. circinatus*, R. aquaticus albus, circinatis tenuissime divisis foliis, floribus ex alis longis pediculis innixis *Pluk. alm.* 311. *t.* 55. 2. *Ray*

* C. Krapf, Experimenta de nonnullorum Ranunculorum venenatâ qualitate, horum externo et interno usu. *Viennæ* 1766. 8vo. p. 107.

† No. 646.

Syn.

Syn. 249. and 4. *R. fluviatilis*, or Ranunculo five Polyanthemo aquatili albo affine, Millefolium maratriphyllum fluitans. *J. B.* iii. 782. Without entering here into any disquisition relative to these distinctions of the species, I shall come to the ultimate object of these observations, by remarking, that I was lately witness to a fact, with respect to the *Ranunculus aquatilis fluviatilis*, which, after what I recollected of the character of the plant, somewhat surprised me, while it sufficiently proved, not merely the innoxious quality of this plant, but that it is nutritive to cattle, and capable of being converted to useful purposes in agricultural economy. Unless these varieties of the *R. aquatilis* Linn. be endowed with different properties, it is a proof that the experiments on this plant were not made with sufficient accuracy, or discrimination of the varieties; not sufficiently repeated on different individuals of the same species of animals; or, that in different countries or situations it is divested of its virulence. In the present instance, it is probable, the plant is rendered inert as a poison, by growing in the water; although in certain other instances, moisture is thought to heighten the deleterious property of vegetables, especially in the umbelliferous tribe.

The fact that I have alluded to is, that in the neighbourhood of Ringwood, on the borders of the Avon, which affords this vegetable in great abundance all the year, some of the cottagers sustain their cows, and even horses, almost wholly by this plant; since the remaining part of their food is nothing more than a scanty pittance they get on the adjacent heath, which affords little more than *Ling*, *Lichen*, Bogmoss or *Sphagnum*, &c. It is usual to employ a man to collect a quantity for the day every morning, and bring it in the boat to the edge of the water, from which the cows, in the instance I saw, stood eating it with great avidity. I was indeed informed they relished it so highly, that it was unsafe to allow them more than a certain quantity; I think between twenty-five and thirty pounds each, daily; but with variation according to circumstances. The cows I saw were apparently not in a mean condition, and gave a sufficient quantity of good milk. I was told by the person whose cattle

were feeding on it, that he kept five cows and one horse so entirely by this plant, and what the heath afforded, that they had not consumed more than half a ton of hay throughout the whole year; none being used, except when the river is frozen over. I examined the whole parcel, on which four cows were feeding, in the beginning of March, and found the whole consisted, exclusively, of the *Ranunculus fluviatilis*, without any mixture of the *Potamogeton*, *Carex*, *Sparganium*, or other aquatic plants. In summer, however, it can scarcely be avoided but that there must be a mixture of some of these: but other plants are not chosen.

This account was confirmed to me by different persons; by whom I was further informed, that hogs are also fed with the same plant, on which they improve so well, that it is not necessary to allow them other sustenance till it is proper to put them up to fatten.

This relation, while it shows how carefully experiments should be conducted before a decisive judgment on the powers of any reputedly poisonous vegetable can be formed, may induce such as were unacquainted with this fact to adopt the use of this plant in similar situations, since it is one of the most frequent in many rivers of this kingdom. The application of it to these useful purposes will also answer a secondary good—of tending to clear the streams of what is otherwise considered as a noxious weed; since, by its abundance in summer, it is frequently seen to choke up the rivers more than any other plant, and, from slight falls of rain, contributes much to the overflowing of meadows in hay-time.

V. *Description of the Mus Bursarius, from a Drawing communicated by Major-General Thomas Davies, F. R. S. & L. S. By* GEORGE SHAW, *M.D. F.R.S. V.P.L.S.**

THE *Mus bursarius* belongs to a particular division in the genus, containing such species as are furnished with cheek-pouches for the temporary reception of their food. It seems not to have been yet described, or at least not so

* From the *Transactions of the Linnæan Society*, Vol. V.

distinctly

distinctly as to be easily ascertained. It approaches however to one or two species mentioned by Dr. Pallas, Mr. Pennant, and others; but differs in size, being much larger, as well as in the appearance of the fore-feet, which have claws differently formed from any of the pouched species hitherto described.

In order to secure its knowledge among naturalists, it may be proper to form for it a specific character, *viz.*

Mus cinereus, caudâ tereti brevi subnudâ, genis saccatis, unguibus palmarum maximis fossoriis.

Ash-coloured rat, with short, round, nearly naked tail, pouched cheeks, and the claws of the fore-feet very large, formed for burrowing in the ground.

The cheek-pouches are far larger, in proportion to the animal, than in any other of this tribe, and therefore have given occasion for the specific name. (Plate VIII.)

This quadruped was taken by some Indian hunters in the upper parts of Interior Canada, and sent down to Quebec. It is now in the possession of Governor Prescot.

VI. *On the Analysis of Azot: an Extract of a Letter from Dr.* GIRTANNER *to Dr.* VAN MONS *of Brussels**.

Gottingen, Dec. 26, 1799.

I HAVE been travelling during the greater part of the summer for the restoration of my health. I spent some time in Swisserland, where I met with one of my old friends, an excellent chemist. We repeated, amidst the thunder of cannon, a great number of the experiments I had made on the analysis of azot; and I can now prove that this substance is a compound body. The experiments of Wiegleb and Wurzer are true, whatever the Dutch chemists may say to the contrary; but these experiments, as you may readily conceive, prove nothing against the theory of Lavoisier. I have written a memoir in French on the analysis of azot, which I should send you to be inserted in the Annales, were I certain that it would not be lost by the way.

I am now publishing the third edition of my Principles of

* From the *Annales de Chimie*, No. 99.

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the Antiphlogistic Chemistry, in which you will find new ideas on the acidifiable base of the marine acid. I am certain it is hydrogen; but the acid contains much less oxygen than water.

That I may not leave your curiosity ungratified in regard to the analysis of azot, I must tell you, that it is composed of hydrogen and oxygen in the proportion of 0·21 of the former, and 0·79 of the latter *: it is nothing else, therefore, than an oxyd of hydrogen. All our eudiometry is false, since azot is a production of our eudiometric analysis, and did not exist in the air before the experiment. Alumine or argillaceous earth is the substance most proper for changing atmospheric air into azotic gas. This is the principle on which the production of saltpetre, so much sought after in France at the commencement of the war, depends, and which is now discovered by my experiments.

Hydrogen gas may be transformed into azotic gas by respiration: the oxygen gas, a part of which is always condensed in the lungs, joins itself to the hydrogen, and changes it into azot. The same conversion may be effected, and in a much more sensible manner, by bringing hydrogen gas into contact with moistened argil.

VII. *Description of the Method employed at Astracan for making grained Parchment or Shagreen. By Professor* PALLAS.

THE process for preparing shagreen is a very old oriental invention, not practised in Europe, and which, as far as I know, has never yet been described; though Basil Valentin †

* In our last we announced this discovery of Dr. Girtanner, and gave Dr. Van Mons's letter to C. Delametherie upon the subject, by which the proportions were stated to be hydrogen 93, and oxygen 7. We are inclined to think the present is the result obtained by later experiments, as the former was copied from the *Journal de Physique* for Nivose, which answers to the end of December and 21 days of January. EDIT.

† See *M. B. Valentini Museum Museorum oder Vollständige Schaubühne aller materiallien und specereyen*, p. 439.

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is pretty right in what he ſays of it in general. It is one of thoſe arts of the Eaſt, which, like that of the Turkey dye for cotton, the preparation of Ruſſia leather, iſinglaſs, &c. have remained unknown and unemployed, not becauſe they are kept ſecrets, but becauſe none of the European travellers ever took the trouble to learn them, and becauſe the materials uſed are not ſo common and ſo cheap in Europe. It may be of ſome utility, therefore, if I here give a circumſtantial deſcription of this art as it is practiſed at Aſtracan by the Tartars and Armenians, eſpecially as the method of theſe people is perfectly ſimilar to that uſed in Turkey, Perſia, and various parts of Bucharia, and as the ſhagreen-makers of Aſtracan acknowledge that they obtained the proceſs originally from Perſia.

All kinds of horſes' or aſſes' ſkin, which have been dreſſed in ſuch a manner as to appear grained, are by the Tartars called *ſauwer*, by the Perſians *ſogre*, and by the Turks *ſagri*, from which the Europeans have made *ſhagreen* or *chagrin*. The Tartars who reſide at Aſtracan, with a few of the Armenians of that city, are the only people in the Ruſſian empire acquainted with the art of making ſhagreen. Thoſe who follow this occupation not only gain conſiderable profit by the ſale of their production to the Tartars of Cuban, Aſtracan, and Caſan, who ornament with it their Turkey leather boots, ſlippers, and other articles made of leather; but they derive conſiderable advantage from the great ſale of horſes' hides, which have undergone no other proceſs than that of being ſcraped clean, and of which ſeveral thouſands are annually exported, at the rate of from 75 to 85 roubles *per* hundred, to Perſia, where there is a ſcarcity of ſuch hides, and from which the greater part of the ſhagreen manufactured in that country is prepared. The hind part only of the hide, however, which is cut out in the form of a creſcent about a Ruſſian ell and a half in length acroſs the loins, and a ſhort ell in breadth along the back, can properly be employed for ſhagreen. The remaining part, as is proved by experience, is improper for that purpoſe, and is therefore rejected.

The preparation of the ſkins, after being cut into the above form, is as follows:—They are depoſited in a tub filled with

pure

pure water, and ſuffered to remain there for ſeveral days, till they are thoroughly ſoaked; and the hair has dropped off. They are then taken from the tub, one by one, extended on boards placed in an oblique direction againſt a wall, the corners of them, which reach beyond the edges of the board, being made faſt, and the hair with the epidermis is then ſcraped off with a blunt iron ſcraper called *urak*. The ſkins thus cleaned are again put in pure water to ſoak. When all the ſkins have undergone this part of the proceſs, they are taken from the water a ſecond time, ſpread out one after the other as before, and the fleſh ſide is ſcraped with the ſame kind of inſtrument. They are carefully cleaned alſo on the hair ſide, ſo that nothing remains but the pure fibrous tiſſue, which ſerves for making parchment, conſiſting of coats of white medullary fibres, and which has a reſemblance to a ſwine's bladder ſoftened in water.

After this preparation, the workmen take a certain kind of frames called *pälzi*, made of a ſtraight and a ſemi-circular piece of wood, having nearly the ſame form as the ſkins. On theſe the ſkins are extended in as ſmooth and even a manner as poſſible by means of cords; and during the operation of extending them they are ſeveral times beſprinkled with water, that no part of them may be dry, and occaſion an unequal tenſion. After they have been all extended on the frames, they are again moiſtened, and carried into the houſe, where the frames are depoſited cloſe to each other on the floor with the fleſh ſide of the ſkin next the ground. The upper ſide is then thickly beſtrewed with the black exceedingly ſmooth and hard ſeeds of a kind of gooſe-foot, (*chenopodium album* *) which the Tartars call *alabuta*, and which grows in abundance, to about the height of a man, near the gardens and farms on the ſouth ſide of the Volga; and that they may make a ſtrong impreſſion on the ſkins, a piece of felt is ſpread over them, and the ſeeds are trod down with the feet, by which means they are deeply imprinted into the ſoft ſkins.

* This chenopodium is often uſed as food by the German coloniſts on the Volga, on account of the frequent failure of their crops. They employ it either as a ſubſtitute for greens, or pound the ſeeds, and, with the addition of a little meal, form them into bread.

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The frames, without ſhaking the ſeeds, are then carried out into the open air, and placed in a reclining poſition againſt a wall to dry, the ſide covered with the ſeeds being next the wall, in order that it may be ſheltered from the ſun. In this ſtate the ſkins muſt be left ſeveral days to dry in the ſun, until no appearance of moiſture is obſerved in them; when they are fit to be taken from the frames. When the impreſſed ſeeds are beat off from the hair ſide, it appears full of indentations or inequalities, and has acquired that impreſſion which is to produce the grain of the ſhagreen, after the ſkins have been ſubjected to the laſt ſmoothing or ſcraping, and have been dipped in a ley, which will be mentioned hereafter, before they receive the dye.

The operation of ſmoothing is performed on an inclined bench or board, which is furniſhed with an iron hook, and is covered with thick felt or ſheep's wool, on which the dry ſkin may gently reſt. The ſkin is ſuſpended in the middle of the bench or board to its iron hook, by means of one of the holes made in the edge of the ſkin for extending it in its frame as before mentioned; and a cord, having at its extremity a ſtone or a weight, is attached to each end of the ſkin, to keep it in its poſition while under the hands of the workman. It is then ſubjected to the operation of ſmoothing and ſcraping by means of two different inſtruments. The firſt uſed for this purpoſe, called by the Tartars *tokar*, is a piece of ſharp iron bent like a hook, with which the ſurface of the ſhagreen is pretty cloſely ſcraped to remove all the projecting inequalities. This operation, on account of the corneous hardneſs of the dry ſkin, is attended with ſome difficulty; and great caution is at the ſame time required that too much of the impreſſion of the *alabuta* ſeed be not deſtroyed, which might be the caſe if the iron were kept too ſharp. As the iron, however, is pretty blunt, which occaſions inequalities on the ſhagreen, this inconvenience muſt afterwards be remedied by means of a ſharp ſcraping-iron or *urak*, by which the ſurface acquires a perfect uniformity, and only faint impreſſions of the *alabuta* ſeed then remain, and ſuch as the workman wiſhes. After all theſe operations, the ſhagreen is again put into water, partly to make it pliable, and partly to

raiſe

raiſe the grain. As the ſeeds occaſion indentations in the ſurface of the ſkin, the intermediate ſpaces, by the operations of ſmoothing and ſcraping, loſe ſome part of their projecting ſubſtance; but the points which have been depreſſed, and which have loſt none of their ſubſtance, now ſwell up above the ſcraped parts, and thus form the grain of the ſhagreen. To produce this effect, the ſkins are left to ſoak in water for twenty-four hours; after which they are immerſed ſeveral times in a ſtrong warm ley, obtained, by boiling, from a ſtrong alkaline earth named *ſchora*, which is found in great abundance in the neighbourhood of Aſtracan. When the ſkins have been taken from this ley, they are piled up, while warm, on each other, and ſuffered to remain in that ſtate ſeveral hours; by which means they ſwell, and become ſoft. They are then left twenty-four hours in a moderately ſtrong pickle of common ſalt, which renders them exceedingly white and beautiful, and fit for receiving any colour. The colour moſt uſual for theſe ſkins is a ſea-green; but old experienced workmen can dye them blue, red, or black, and even make white ſhagreen.

For the green colour nothing is neceſſary but filings of copper and ſal-ammoniac. Sal-ammoniac is diſſolved in water till the water is completely ſaturated; and the ſhagreen ſkins, ſtill moiſt, after being taken from the pickle, are waſhed over with the ſolution on the ungrained fleſh ſide, and when well moiſtened a thick layer of copper filings is ſtrewed over them: the ſkins are then folded double, ſo that the ſide covered with the filings is innermoſt. Each ſkin is then rolled up in a piece of felt; the rolls are all ranged together in proper order, and they are preſſed down in an uniform manner by ſome heavy bodies placed over them, under which they remain twenty-four hours. During that period the ſolution of ſal-ammoniac diſſolves a quantity of the cupreous particles ſufficient to penetrate the ſkin and to give it a ſea-green colour. If the firſt application be not ſufficient, the proceſs is repeated in the ſame manner; after which the ſkins are ſpread out and dried.

For the blue dye, indigo is uſed. About two pounds of it, reduced to a fine powder, are put into a kettle; cold water is poured

poured over it, and the mixture is ſtirred round till the colour begins to be diſſolved. Five pounds of pounded *alakar*, which is a kind of barilla or crude ſoda, prepared by the Armenians and Calmucs, is then diſſolved in it, with two pounds of lime * and a pound of pure honey, and the whole is kept ſeveral days in the ſun,-and during that time frequently ſtirred round. The ſkins intended to be dyed blue muſt be moiſtened only in the natrous ley *ſchora*, but not in the ſalt brine. When ſtill moiſt, they are folded up and ſewed together at the edge, the fleſh ſide being innermoſt, and the ſhagreened hair ſide outwards; after which they are dipped three times in the remains of an exhauſted kettle of the ſame dye, the ſuperfluous dye being each time expreſſed; and after this proceſs they are dipped in the freſh dye prepared as above, which muſt not be expreſſed. The ſkins are then hung up in the ſhade to dry; after which they are cleaned and paired at the edges.

For black ſhagreen, gall-nuts and vitriol are employed in the following manner:—The ſkins, moiſt from the pickle, are thickly beſtrewed with finely pulveriſed gall-nuts. They are then folded together, and laid over each other for twenty-four hours. A new ley, of bitter ſaline earth or *ſchora*, is in the mean time prepared, and poured hot into ſmall troughs. In this ley each ſkin is ſeveral times dipped; after which they are again beſtrewed with pounded gall-nuts, and placed in heaps for a certain period, that the galls may thoroughly penetrate them, and they are dried and beat, to free them from the duſt of the galls. When this is done, they are rubbed over, on the ſhagreen ſide, with melted ſheep's tallow, and expoſed a little in the ſun, that they may imbibe the greaſe. The ſhagreen-makers are accuſtomed alſo to roll up each ſkin ſeparately, and to preſs or ſqueeze it with their hands againſt ſome hard ſubſtance, in order to promote the abſorption of the tallow. The ſuperfluous particles are removed by means of a blunt wooden ſcraper (*urak*); and when this proceſs is finiſhed, and the ſkins have lain ſome time, a ſuffi-

* Quick-lime is probably meant here, which, by taking up the carbonic acid of the alkali, and thereby rendering it cauſtic, will enable it to effect a mechanical ſolution, or rather an impalpable comminution, of the indigo. Edit.

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cient quantity of vitriol of iron is diſſolved in water, with which the ſhagreen is moiſtened on both ſides, and by this operation it acquires a beautiful black dye. It is then dreſſed at the edges, and in other places where there are any blemiſhes.

To obtain white ſhagreen, the ſkins muſt firſt be moiſtened, on the ſhagreen ſide, with a ſtrong ſolution of alum. When the ſkin has imbibed this liquor, it is daubed over on both ſides with a paſte made of flour, which is ſuffered to dry. The paſte is then waſhed off with alum-water, and the ſkin is placed in the ſun till it is completely dry. As ſoon as it is dry, it is gently beſmeared with pure melted ſheep's tallow, which it is ſuffered to imbibe in the ſun; and, to promote the effect, it is preſſed and worked with the hands. The ſkins are then faſtened in ſucceſſion to the before-mentioned bench, where warm water is poured over them, and the ſuperfluous fat is ſcraped off with a blunt wooden inſtrument. In the laſt operation the warm water is of great ſervice. In this manner ſhagreen perfectly white is obtained, and nothing remains but to pair the edges and dreſs it.

But this white ſhagreen is not intended ſo much for remaining in that ſtate as for receiving a dark red dye, becauſe, by the above previous proceſs, the colour becomes much more perfect. The ſkins deſtined for a red colour muſt not be immerſed firſt in ley of bitter ſalt earth (*ſchora*), and then in pickle, but, after they have been whitened, muſt be left to ſoak in the pickle for twenty-four hours. The dye is prepared from cochineal, which the Tartars call *kirmitz*. About a pound of the dried herb *tſchagann*, which grows in great abundance in the neighbourhood of Aſtracan, and is a kind of ſoda-plant or kali, (*ſalſola ericoides**,) is boiled a full hour in a kettle containing about four common pailfulls of water; by which means the water acquires a greeniſh co-

* The beautiful red Turkey leather is dyed with cochineal prepared in the ſame manner. Profeſſor Gmelin junior, in the ſecond part of his Travels through Ruſſia, explains the herb *tſchagann* by *artemiſia annua*, having doubtleſs been deceived by the appearance the plant acquires after it has been dried. Beſides, this *artemiſia* is found only in the middle of Siberia, and never on the weſt ſide of the Irtiſch.

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lour. The herb is then taken out, and about half a pound of pounded cochineal is put into the kettle, and the liquor is left to boil a full hour, care being taken to ſtir it that it may not run over. About 15 or 20 drams of a ſubſtance which the dyers call *lüter* (orchilla) is added, and when the liquor has been boiled for ſome time longer the kettle is removed from the fire. The ſkins taken from the pickle are then placed over each other in troughs, and the dye-liquor is poured over them four different times, and rubbed into them with the hands, that the colour may be equally imbibed and diffuſed. The liquor each time is expreſſed; after which they are fit for being dried. Skins prepared in this manner are ſold at a much dearer rate than any of the other kinds.

VIII. *On that Diſeaſe peculiar to Poland and ſome of the neighbouring Countries, called the Plica Polonica.*

THE celebrated Profeſſor Brera, who reſided in Poland during the ſummer of the year 1795, and who had a good opportunity of making obſervations on this ſingular diſeaſe in the country to which it is peculiar, has publiſhed the following account of it:—“ Under the term *plica polonica* is underſtood a diſeaſe by which the hair on the head and other parts of the body ſwells, becomes matted together, and forms hard knots, and, on being touched, occaſions the moſt acute pain. The patient at the ſame time is ſeized with a kind of nervous fever, and the functions of the brain are deranged. This diſeaſe prevails throughout all Poland; but it ſeems to be more peculiar to Lithuania, where the inhabitants, of every age and condition, are, ſooner or later, attacked by it. Sometimes it is found among the wild animals, but oftener among the domeſtic, and moſt frequently among horſes. In Lower Hungary, the Bannat, Croatia, and Sclavonia, there is at preſent a ſimilar diſeaſe, from which foreigners who reſide long in thoſe countries ſuffer more than the natives.

“ The ſymptoms of this dreadful malady in general are, ſleep diſturbed by terrible dreams, a ſudden depreſſion of the ſpirits, and a loathing of every kind of food. A few

days

days after, gouty pains are felt, ſometimes in the arms, and ſometimes in the knees. The diſeaſe then more and more manifeſts itſelf, accompanied with a fever, at firſt of a doubtful nature, but which commonly exhibits a nervous character, the affections of which ſtill increaſe. The phyſicians, in thoſe countries where this diſeaſe prevails, often treat it in an improper manner, and waſte the time in the application of palliatives. The pains, uneaſineſs, and other affections, are, however, ſometimes leſſened by the common mode of treatment, and the patient often recovers in ſome meaſure his appetite, and might entertain hopes of a cure, did not a ſhivering of the whole body, and a ſtronger or weaker heat which follows, with violent pains and an uncommon heavineſs, remind him too much of the lurking evil. Uncertain reſpecting the event, he wanders about for ſeveral months, and, inſtead of health, the diſeaſe returns with more violence than ever. The pains in the limbs become more acute, the itching in the arms greater, and the patient remains confined to his bed. The hair begins gradually to ſwell, and to become clammy, and a fixed pain takes place above the ſocket of the eye, and gradually extends over the whole forehead. The functions of the brain begin to be deranged; all objects ſeem to the patient to have an appearance different from what they uſually have; and he is frequently ſeized with fits of giddineſs, and even blindneſs. He is at the ſame time tormented with intolerable thirſt, and experiences a violent ſenſation of burning in the throat, and over the whole ſkin. The urine is commonly turbid, almoſt of a coffee-brown colour, and gives a dark ſediment. The body is coſtive.

“ Under theſe circumſtances the diſeaſe increaſes, and it then becomes high time to apply means for leſſening, or rather removing, if poſſible, thoſe affections which threaten the life of the patient. This is the critical period for bringing the diſeaſe, as the Poliſh phyſicians ſay, to maturity. When this is accompliſhed, the patient will be paſt all danger. The ſureſt means of effecting this end is, to endeavour to excite perſpiration; for which purpoſe the warm bath, ſtrengthened with a decoction of aromatic or other herbs according to

circumſtances, and which the patient ought to uſe every day, is to be recommended. At other times, the body muſt often be rubbed with flannel, in order to maintain a determination of the juices towards the ſkin. Diluent medicines, ſuch as the extract of bitters, ſoap, hemlock, and mercurius dulcis if no ſcorbutic diatheſis exiſts, are to be adminiſtered internally. It has been confirmed by repeated experiments, that ſtrong perſpiration, often continued, for ſeveral days, is the conſequence of this treatment. The matter perſpired is in general exceedingly clammy, and has a nauſeous fœtid ſmell. In conſequence of this perſpiration the morbid affections gradually diſappear, the patient feels himſelf lighter, and might imagine himſelf quite well, were he not obliged to drag about a heavy load of filthy matted hair, filled with a multitude of ſmall worms *. By cutting off the hair, the patient would be expoſed to the utmoſt danger: the conſequences are, blindneſs, incurable convulſions, and often death. There is an inſtance of a lady, who, after having been almoſt cured, died ſuddenly on attempting to draw a comb, even with the utmoſt gentleneſs, through her hair. The beſt method is, to bear the inconvenience with patience for three or four years. At the favourable period when the hair begins to be diſengaged, at which time the young hair is ſeen ſpringing up, the following rules are to be obſerved:—A place is to be ſought for in the head where the matted hair is looſe and raiſed up: into this place the finger muſt be thruſt, and the operator muſt endeavour, but without uſing force, to looſen it every where around; and this proceſs muſt be daily repeated, ſometimes in one place and ſometimes in another. The hair which has been completely diſengaged is then to be cut with great caution. After this operation, ſhould the pain in the orbit of the eye return, and if giddineſs, accompanied with convulſive movements in the arms, ſhould take place, the operation of diſengaging the hair muſt be ſuſpended, and bathing be reſumed. By theſe means the affections not only diſappear, but the remaining clotted hair often becomes looſened of itſelf. In this diſeaſe

* The uſe of hair-powder, it is ſaid, was firſt introduced for the purpoſe of concealing the deformity occaſioned by this diſeaſe. EDIT.

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the hair often ſwells in ſuch a manner that blood iſſues from it when cut."

Dr. Brera is of opinion, that this terrible diſeaſe is not to be aſcribed, as ſome believe, to the dirtineſs of the people in Poland.

IX. *On the Ammoniure of Cobalt, and an Acid contained in the Grey Oxyd of that Metal known under the Name of Zaffar.* *By* L. BRUGNATELLI *.

THE metallic ammoniures have for ſome time paſt engaged my attention. Theſe compounds reſult from a chemical combination of ammonia with metals. Hitherto they have been little examined, that of copper excepted, notwithſtanding their characteriſtic properties, which diſtinguiſh them from other bodies. The ammoniure, which firſt became the object of my reſearches, was that of cobalt †. The particularities which it preſented are as follows:—

1. I had ſeveral times obſerved that the precipitate, formed by ammonia in a ſolution of the nitrat of cobalt, was re-diſſolved in that alkali. I collected ſome of it on a filter, and waſhed and dried it. On half an ounce of this precipitate, which was of a dark colour, I poured two ounces of liquid ammonia, ſtopped the bottle, and left it at reſt. The temperature of the atmoſphere was 20° above zero of Reaumur. At the end of twenty-four hours the alkali had aſſumed a dark-red colour ‡, and the precipitate was entirely diſſolved. I thought I had formed a pure ammoniure, but I endeavoured to procure a larger quantity by other means.

2. I tried to diſſolve ſmalt or blue cobalt in cauſtic ammonia, but without ſucceſs, even when long digeſtion was employed;

* From the *Annales de Chimie*, No. 98.

† I have ſince examined the ammoniures of mercury, zinc, copper, and arſenic.

‡ Bergman had obſerved only that ammonia aſſumed a red colour with cobalt. *Cobaltum*, ſays he, *a niccolo differt quod omnibus acidis et alcali volatili ſolvatur colore rubro.* This circumſtance has been noticed by all chemiſts without adding any thing to it.

employed; but I eafily fucceeded in diffolving the grey oxyd of this metal, commonly called *zaffar*. This fubftance afforded me the means of eafily procuring ammoniure in abundance, and permitted me to repeat and vary my experiments different ways.

3. I evaporated to drynefs the ammoniure obtained from zaffar. The concrete refiduum I obtained, was compofed of two very diftinct fubftances; one of which had a dark red, and the other a pale-yellowifh colour.

4. I poured diftilled water on this refiduum, ftirring the matter with a glafs fpatula. The red part was entirely diffolved, and communicated to the water a beautiful rofe colour. The yellowifh matter remained undiffolved.

5. The yellowifh fubftance may be obtained during the evaporation of the liquid ammoniure, from which it begins to be feparated at the moment when it is reduced to half its bulk. The red fubftance remains diffolved in the laft quarter of the liquid *.

6. The ammonia then takes from the zaffar, and holds in folution, two very diftinct matters; one of which, foluble in water, has a red colour; and the other, infoluble in the fame liquid, has a yellowifh colour. The latter fubftance is the pure oxyd of cobalt. I think I difcovered in the former a peculiar acid, diftinct from all the other acids known.

Of the pure Oxyd of Cobalt.

7. The yellowifh fubftance, which is feparated by the flow evaporation of the ammoniure in the air or in the fun, may be confidered as the pure oxyd of cobalt. It is infipid, inodorous, infoluble in water, and foluble in all the mineral acids. The nitro-muriatic acid forms with it a yellowifh folution, which is in great meafure deprived of its colour by the addition of a little diftilled water.

8. This folution may be employed for fympathetic ink, like the common nitro-muriat of cobalt. Sometimes the acid refufes to diffolve the whole of the oxyd, but by adding a little water the folution is completed.

* By preferving ammoniure of cobalt for fome time, even in bottles well ftopped, there is feparated from it a yellow matter.

9. This

9. This ſolution is precipitated by the pruſſiat of pot-aſh of a blueiſh-green colour, which does not change. It is not precipitated by the gallic acid, but the mixture acquires a darker colour. In other reſpects this ſolution exhibits all the phenomena of a common ſolution of cobalt in the ſame acid.

10. The muriatic acid diſſolves exceedingly well the yellow oxyd, and aſſumes a beautiful highly-charged green colour. This colour immediately diſappears with the nitric acid as well as with a little water, but it reappears by the addition of a little of the muriatic acid well concentrated.

Of the pure Ammoniure of Cobalt.

11. The yellow oxyd diſſolves entirely in ammonia, and forms pure ammoniure of cobalt. This ammoniure has a yellow, and ſometimes a roſe, colour. It is not decompoſed by acids. It is deprived of its colour by the muriatic acid. The pruſſiat of pot-aſh changes it to grey, and occaſions afterwards a depoſit of the ſame colour. The ſulphure of pot-aſh makes it aſſume a dark colour inclining to black, and precipitates from it ſulphure of cobalt *. The borat (alkaline) of ſoda is decompoſed by it, and precipitated into borat of cobalt of a very white colour.

On the Acid drawn from the Ammoniure of Cobalt, and its Properties.

12. The red ſubſtance of the preceding experiments was ſeparated from the yellow oxyd. For this purpoſe I evaporated in the ſun liquid ammoniure; and when it was reduced to about the fourth of its volume, and no longer precipitated in a ſenſible manner yellow oxyd, I filtered it through paper. What paſſed had a dark red colour, like decoction of cochineal. This liquor emitted no odour, but had a very pungent taſte: it was again expoſed to the ſun till it was perfectly deſiccated.

13. The remaining maſs was diſſolved in diſtilled water, which

* The ſulphure of cobalt dried in the air approaches in colour to zaffar. When rubbed on paper it aſſumes a metallic ſplendour like the greater part of the other metallic ſulphures: when heated it emits a ſulphureous odour, and inflames when thrown on burning coals.

which was tinged of a beautiful ruby colour. This ſolution manifeſted an unequivocal character of acidity. On cooling, it depoſited ſome ſmall brilliant cryſtals, which I found to be a combination of the acid with ammonia. As this acid ſeemed to be diſtinct from all the other acids, I have given it the peculiar name of the *cobaltic acid*.

14. To aſcertain whether the cobaltic acid could be ſeparated from the ammoniure of cobalt by means of heat, I ſubjected a pound of it to diſtillation in a retort. After three-fourths of the liquid had paſſed into the receiver I ſtopped the diſtillation, and found that the retort contained a liquid rendered turbid by the yellow oxyd precipitated. I decanted the liquid after the precipitate had depoſited itſelf, and evaporated it to dryneſs. The reſiduum was yellowiſh, and partly ſoluble in water, to which it communicated a yellow tint. This ſolution poſſeſſed all the acid characters of the red liquid of No. 15.

15. In another experiment I put a pound of the ammoniure of cobalt into a retort, and carried the diſtillation to dryneſs. The cooled matter which remained at the bottom of the retort was blue; but it had this colour only at its ſurface, being internally yellow. After ſome hours this blue colour diſappeared, and the maſs aſſumed a red colour.

16. A remarkable difference between the reſiduum of the evaporation in the ſun and that by fire is, that the latter gave up to the water the cobaltic acid almoſt colourleſs, ſo that the ſolution, filtered cold, was almoſt as limpid as water. I remarked beſides, that by the latter proceſs the acid does not contain any, or contains very little, of cobalt of ammonia (*cobalt d'ammoniaque*).

I ſhall now enumerate the principal characters by which the new acid is diſtinguiſhed.

1. It preſents itſelf under a concrete form, and is not volatiliſed by fire.

2. It is ſometimes of a red colour, ſometimes pale yellow, and at other times entirely colourleſs.

3. It has no ſmell.

4. It has an acid, pungent, but not diſagreeable taſte.

5. It gives a tinge of bright red to an infuſion of turnſol.

6. It

6. It is perfectly ſoluble in water.

7. It decompoſes all the alkaline ſulphures from which it precipitates the ſulphur.

8. It precipitates ammoniure of copper of a bright green, and that of zinc of a pure white colour.

9. It precipitates the ſulphat of copper of the ſame colour as the ammoniure of that metal.

10. It precipitates the nitrat of ſilver white;

11. The nitro-muriat of tin the ſame;

12. The nitrat of mercury of a clear ſtraw colour;

13. The acetite of lead white.

14. It does not make any ſenſible change in ſolutions of gold and platina.

15. It precipitates lime-water in a white coagulum inſoluble in water, and ſuper-ſaturated with acid.

16. It precipitates the acetite and muriat of barytes.

17. It is ſeparated from the water which holds it in ſolution by alcohol.

18. Employed as a ſympathetic ink, it is not coloured green or blue like ſolutions of cobalt, but renders the paper brown and then black when it has been expoſed to a ſtrong heat, as is the caſe with other acids.

19. With tincture of gall-nuts newly made, it forms an abundant yellowiſh precipitate.

20. With a ſaturated ſolution of ſoda it gives an irregular tranſparent ſalt ſoluble in water, but not deliqueſcent in the air.

21. With pot-aſh it forms a ſalt cryſtalliſable in ſquare cryſtals, tranſparent, and not deliqueſcent in the open air;

22. With ammonia a ſalt ſoluble in its acid;

23. With barytes an opake ſalt cryſtalliſable with difficulty.

The preſence of an acid in zaffar made me ſuſpect that this acid might be of an arſenical nature; but this doubt ſoon vaniſhed by comparing the characters of the two acids.

1ſt, The arſenic acid does not precipitate ſolutions of ſilver like the cobaltic acid. 2d, The arſenic acid precipitates lime-water: this arſeniate is rediſſolved by the acid as well as by a freſh quantity of lime-water. The contrary is the

cafe with the acid of cobalt. 3d, The arfenic does not, like the cobaltic acid, decompofe the muriat and the acetite of barytes. 4th, The arfenic acid is foluble in alcohol, which precipitates the cobaltic acid under a concrete form.

It remained to be afcertained whether the acid extracted from zaffar exifted already formed in that oxyd, or whether it was produced by the action of the ammonia.

As the acid of cobalt readily diffolves in water, I boiled fix pounds of zaffar in eight pounds of water for a quarter of an hour, and filtered the liquor while warm. What paffed was tranfparent and colourlefs, but manifefted a fenfible tafte. I evaporated the liquid, taking care to cover the veffel with a piece of filk. When reduced to one-half it became turbid, without the fubftance which was feparated appearing fenfibly coloured. I continued the evaporation till a third only of the liquor remained. When I removed it from the fire there was depofited a very white matter, which, on coming into contact with the air, affumed a beautiful rofe colour. I feparated this matter, and collected it on the filter.

The liquor which paffed had a bright-yellow colour, and was perfectly tranfparent. It manifefted in a decided manner an acid tafte; reddened tincture of turnfol; fpeedily decompofed lime-water, falts of barytes, and thofe of filver; was precipitated with alcohol, &c. In a word, it exhibited all the properties of the cobaltic acid obtained by the proceffes before mentioned.

The red depofit which remained on the filter was infipid, and gave to the muriatic acid a very beautiful green colour. It was the pure oxyd of cobalt. This oxyd diffolved in a large quantity in its acid, and was precipitated from it in proportion as the latter was concentrated. The acid which the ammonia had feparated from the zaffar was found then entirely formed in that fubftance. It ftill remains to be determined, in a pofitive manner, what is its radical. In the mean time I thought it my duty to retain its name of the *cobaltic acid.*

X. *Ob-*

X. *Obſervations reſpecting Oyſters, and the Places where found.* *By Profeſſor* BECKMANN.

[Concluded from Page 103.]

IRELAND has very abundant oyſter-banks near the village of Arklow, on the eaſtern ſide of Dublin, from which ſeed is conveyed to the artificial beds of the capital on the northern ſide near Clontarf; and further ſouth, at Sutton, not far from Howth. Alſo at Polebeg and Dalkey, not far from Dublin; and particularly Ireland's Eye, where the largeſt and beſt oyſters lie at the depth of about eighteen or twenty fathoms under the water. Likewiſe to the north of Dublin, near Ruſh and Skerries, where the oyſters are ſalter and harder than in places where more freſh water falls into the ſea *. Scotland has great abundance of oyſters near the iſland of Inch Keith, which is not far from Leith.

I have no intention of enumerating all the places where oyſter-beds are found; but I ſhall here give a liſt of thoſe with which I am acquainted, becauſe it perhaps may be of uſe to travellers who think objects of this kind not unworthy of their notice. Theſe ſhell-fiſh are found in various places on the coaſt of France; ſuch as the mouth of the Seine, where, though few in number, they are of an excellent quality. On the coaſt of Caen, in Normandy, there is a bank ſix miles in length and one in breadth. They are found alſo in the Bay of Iſigny, and in the neighbourhood of Cherbourg. Thoſe in particular are highly valued which are collected at the mouths of ſome ſtreams where the ſea-water is ſometimes thrown entirely back, and which are called *huitres de pied*. Granville, in Normandy, gains 50,000 livres † by this fiſhery. On the coaſt of Brittany there are very large oyſters, particularly at Concalle, where a great many are preſerved in places encloſed for the purpoſe. The bank at Painpol is almoſt entirely exhauſted. At the mouth of the Loire; between the rocks on the coaſt of Poitou, on the coaſt of Aunis and Saintonge, where thoſe who make bay-ſalt tranſplant oyſters to marſhy

* Natural Hiſtory of the County of Dublin, by Rutty, Vol. I. p. 376.

† This at leaſt is aſſerted in *Voyage dans les departements de la France.*

marſhy places, in which they acquire a better quality, though they never become ſo good as the green ones of Saintonge: alſo *à la tête de Buch*, near Bourdeaux. In Languedoc, near Cape Leucate, there is an oyſter-bank at the depth of twenty feet. At the mouth of the Rhone, on the coaſt of Provence. At Paris thoſe oyſters are moſt eſteemed which come from Bretagne, Rochelle, Bourdeaux, and particularly from Medoc.

The Dutch have ſome oyſter-beds on the coaſt of Zealand, near Zierikzee; oyſters are kept there alſo in pits as well as at the town of Brouwerſhaven, and particularly at Petten in North Holland: thoſe of the laſt-mentioned place are much eſteemed, and are known under the name of Petten oyſters. For theſe pits * many ſhip loads are tranſported every year from the coaſts of England.

There are exceedingly rich oyſter-banks in the duchy of Holſtein and in the neighbourhood of Jutland, which ſupply moſt of the oyſters uſed in the northern part of Germany. I entertained hopes that we ſhould have obtained a complete deſcription of theſe oyſter-beds in the highly valuable collection of the *Provinzial-blättern* of Schleſwig-Holſtein, as well as of the trade to which they give riſe; but hitherto this hope, as far as I know, has never been realiſed. It gives me greater pleaſure, therefore, to be able to ſupply in ſome meaſure this deficiency by the information on that ſubject, which, by the means of Profeſſor Tychſen and M. Adler, I obtained from M. Todſen, a clergyman at Uberg near Tondern.

The royal oyſter-beds lie all together on the weſtern coaſt of the duchy of Schleſwig, between the iſlands Fanöe, Rom or Romöe, Sylt, Föhr, Amröm, Nordſtrand, Silworm, Süderog, and extend from the diſtrict of Ripen to Helgoland. The number of the beds from which oyſters can be fiſhed is at preſent reckoned to be fifty: the greater part of them take

* *Oeſterpulten waarin de oeſters geſpeend worden.* Oyſter-banks firſt aroſe on the coaſts of Holland about the beginning of this century, a few years before it began to be obſerved that ſhips were deſtroyed by ſea-worms, as we are informed by Sellius in his *Hiſt. nat. teredinum*, p. 289. See alſo Leeuwenhock's *Arcana naturæ*, or *Experimenta et contemplat.* p. 459.

their

their names from the perſons by whom they were diſcovered. Some of them are a furlong, ſome a quarter of a mile, and ſome half a mile in length; and their breadth is equally various. M. Todſen aſcribes, and with great propriety, the excellent quality of theſe oyſters to the water which in the ſpring is ſwept by a continued eaſt wind that blows from the continent through the canal and ſluices. The oyſters of theſe different banks are not all of the ſame kind; in ſome they are large, in others of a moderate ſize, and in many only ſmall: the laſt, were they left to grow older, would never attain to a larger ſize. The large oyſters are called *deputat-auſtern*, the reſt *kaufmanſauſtern*. Till the year 1794, the royal chamber of domains let theſe oyſter-banks to the higheſt bidder for the term of ſix years; but as this period was too ſhort for the perſons who took the leaſe, and prejudicial to the fiſhery, they were let to the preſent leſſee, M. Aſmuſſen, merchant in Tondern, during his natural life, from the year 1795, for the yearly ſum of 7505 dollars, which muſt always be paid in advance. He has bound himſelf to furniſh yearly 112½ barrels of oyſters to be delivered from time to time, but each time never leſs than four, and never more than eight barrels, carriage free, at Haderſleben, for the royal family. This city is diſtant about ten miles from the village of Hoyer, where the oyſters are landed, and which is a mile from Tondern. The leſſee is permitted to fiſh for and ſell oyſters only during the four laſt and the four firſt months of the year. The inſtruments uſed for fiſhing up theſe oyſters are of the ſame kind as thoſe employed in other countries. The moſt common is a kind of drag-net made of thongs of ſeals-ſkin worked together, and faſtened to an iron frame which ſcrapes up the oyſters. Theſe nets, when the fiſhermen have arrived at the proper place, are let down by means of ropes made faſt to the iron frame. M. Aſmuſſen uſes at preſent eighteen veſſels, which are perfectly ſimilar to thoſe of which figures have been given by Duhamel. The fiſhermen bring their lading either to the above-mentioned village of Hoyer or to Huſum *, which is ſeven

* I have been told by a friend that prayers for the preſervation of this oyſter-

ſeven miles from Tondern. From there the oyſters are conveyed to Apenrade and Flenſburg, and thence in ſhips to the Eaſt Sea, where the conſumption is greateſt, for a barrel ſometimes is ſold there at the rate of 100 roubles. It is not true that they coſt dearer to the natives than to foreigners: a hundred coſt a dollar; and a barrel, containing from 800 to 1000 oyſters, about ten dollars, ſometimes more or leſs.

The number caught, and the conſumption, vary exceedingly in different years. During ſtormy weather and ſevere froſt, none can be fiſhed. The number fiſhed up yearly, the leſſee, for reaſons which cannot be diſapproved, has hitherto kept a ſecret; but it is certain that 2000 barrels would ſcarcely be ſufficient to pay the rent and expences.

Theſe ſhell-fiſh are more or leſs injured by froſt and ſtormy weather, according to the depth at which they lie. Some beds at high tides have only eight, ſome three, and ſome ſcarcely two fathoms water above them; and the laſt ſuffer moſt when continued froſt prevails with a wind from the eaſt or north, becauſe on thoſe occaſions the tide is ſcarcely perceptible on this coaſt. The beds during ſtormy weather are ſometimes covered with ſand and ſea-weeds, but by the ſame cauſe they may be freed from them. Thoſe beds which are in danger of being covered with mud, ſand, ſhells, or ſea-weed, the fiſhermen endeavour to keep clean by continual fiſhing on them; but thoſe beds which contain a great number of young oyſters they ſpare as much as poſſible.

The five-fingered fiſh infeſts theſe beds, but the oyſter-fiſhers call it the ſtar-fiſh. A long red worm, alſo, with a great number of feet, is found among thoſe oyſters which are old and ſickly. Oyſters of three years old are accounted fit for ſale. The leſſee is forbidden, under the ſevereſt penalties, to fiſh up any younger. The fiſhermen muſt carefully ſeparate the young ones from thoſe which are eatable, and throw them back into the beds. To be able to diſtinguiſh the three years old oyſters, it is neceſſary to be well acquainted with the

oyſter-bed were formerly offered up in the church of Huſum; but this has been omitted for ſeveral years paſt, becauſe the owner refuſed to allow the clergyman about two hundred oyſters, which he claimed for performing that duty.

beds

beds where they are found: if this is the case, they may be easily known from the young oysters by their form, and the size of their shell.

The oyster-banks of Jutland lie on the eastern side of the northern extremity, near Fladstrand, a market-town, where there is a passage over to Norway; also at the island of Lessoe, situated in the Cattegat, three miles from Säbie, in the district of Aalborg. Respecting this fishery, several regulations have been published, one of which is dated February 1709. Attempts have often been made to transplant oysters to the large bays which extend from the Cattegat twenty miles across the country, and nearly intersect it; but they have been attended with as little success as those on the coast of Seeland.

Norway has excellent oysters, and in great abundance on the western coasts. The best are those found on the rocks, and called rock-oysters. Many of them are pickled, and sent in jars and other vessels, which contain the sixteenth part of a barrel, to different parts of the East Sea. These oysters often contain pearls; but they are not of a large size, and never have complete splendour.

Sweden has excellent oysters on the coast of Bahus-Län, near the island of Kasterö, a mile west from Strömstad, from which they are sent, as well as from Udewalla, to every part of the kingdom. The fishermen there pretend that, when an oyster-bed has been exhausted, it requires from four to five years before it is again stocked *.

Italy has oysters of different qualities. Those found near Ancona are of a large size, but not very well tasted. Those are accounted the best which are produced in prodigious multitudes near Tarento, in the sea called *Mare Piccolo*, or *Il Picciol Mare*, which is a large bay that extends past Tarento towards the north-east. I mention this circumstance, because in most of the geographical books and charts these names are wanting. I found them only in an old chart of the *Terra di Otranto*, by J. Janson, though they often occur in books of travels.

* Kalm's Wästgötha och Bahuslansdka resa. *Stockholm* 1746. 8vo. p. 119 and 257.

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The Mediterranean ſea, in general, has more ſhell-fiſh than the ocean any where contains in the ſame ſpace; but no part of it is more abundant in this reſpect than the *Golfo Tarantino*, the harbour of the city, and the *Picciol Mare*. Fiſhing is the principal or only occupation of the inhabitants, who chiefly live by it: on this account the greateſt care is taken to preſerve and increaſe the oyſter-beds. At preſent there are ſeven, which belong partly to the king, partly to the clergy, and partly to private perſons. They are all let on leaſe. Thoſe who pay to the proprietors 30 carlini may fiſh for oyſters till St. Andrew's day. It is aſſerted that they bring in yearly 21,348 ducats, and that the duty on all the oyſters and ſhell-fiſh which are ſent from the city amounts to 5615. If we add to this what is gained by the preparation of byſſus (*lana pinna* *) we may eſtimate, according to the aſſertion of the archbiſhop Joſeph Capece-Latro †, the whole annual return at 100,000 ducats. Great care is here taken that the oyſters may not be diſturbed during the time they are ſpawning, and that all the young ones be thrown back again into the ſea. It is generally believed here that all ſhell-fiſh are fatteſt and fulleſt at the time of the full moon.

The oyſters of the *Mare Piccolo* are at preſent to the rich Italians what thoſe of the Lucrine lake were to the ancients ‡. This lake extended in Campania from Baiæ to the lake Avernus, and was ſeparated from the ſea only by a mole; but,

* A kind of ſilky threads, about five or ſix inches in length, which ſome kinds of ſhell-fiſh (*mytilus pinna*) throw out, and with which they attach themſelves to the rocks and other ſolid bodies. When theſe threads are burnt, they emit, as ſilk does, a ſmell like that of urine. The *pinna marina* throws out a *byſſus*, which is fit for being manufactured, and is valued more than wool. At Naples, Meſſina, Palermo, and Corſica, ſtockings, gloves, &c. are made of this ſubſtance. They are exceedingly warm, and are conſidered as preſervatives againſt the gout. EDIT.

† *Memoria ſu i teſtacei di Taranto*, without date or place: the author's name is found only at the end of the preface. See alſo Von Salis *Reiſen in verſchiedene provinzen des Königreichs Neapel*, in the appendix to the firſt volume.

‡ The oyſters of Tarentum alſo were much eſteemed by the ancients. Aulus Gellius, Lib. VII. cap. 16. or rather Varro, reckons the *oſtrea Tarentina* among the greateſt delicacies.

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though it has been celebrated by ſo many poets, it is at preſent only a pond, which is ſcarcely ſufficient for watering cattle. In the year 1538, on St. Michael's day, an earthquake, which had continued ſome time, became ſo violent that the lake retired from its banks, and its baſon was almoſt entirely filled up; as was the caſe, in part, with the lake Avernus. The neighbouring ſmall town of Tripergala was ſwallowed up with all its inhabitants and riches. It contained a great many monks and nuns, who, it is ſaid, led very irregular lives. "It might have been expected," ſays Blainville, "that the gulph would have been ſatisfied with the nuns and monks, and that it would not have carried its revenge further: but this was not the caſe; as a monument to poſterity, it threw up ſuch a quantity of filth, that it produced a mountain a mile in height and four miles in circumference."

The Venetian oyſters I have already mentioned. They are ſent to Vienna, and perhaps further; and thoſe who are accuſtomed to old oyſters are ſaid (no doubt ironically) to find them much more pleaſant than freſh ones when they meet with them in other places *.

For ſome years paſt oyſters have been brought to Hamburgh from the following places, though from many of them their arrival is accidental:—London; Havre; Schelling, an iſland near the coaſt of Weſt Frieſland; Borkum, an iſland near Groningen; Soltkamp, in the province of Groningen; Wangeroeg; Feverſham; Amerum or Amröen, an iſland near Rypen; Schirmerkog, and Feburſon. With the laſt place, to which ſhips, I believe, have gone only within theſe two years, I am not acquainted. The one before, no doubt, means the iſland of Schiermonigkoog, which lies near Frieſland, to the eaſt of the iſland of Ameland. Wangeroeg is

* Becher, in his *Närriſch Weiſheit*, p. 201, juſtly ridicules the propoſal of William Schröder, ſon of the then chancellor of Gotha, for ſtocking the ponds in the gardens of Vienna with oyſter-brood: for oyſters require ſalt water; and even new beds formed in the ſea do not always ſucceed. The Society for the Encouragement of the Arts at London has often offered premiums on this ſubject. See *Memoirs of Agriculture*, by Doſſie. *London* 1763, Vol. I. p. 307.

an iſland which belongs to the lordſhip of Jever, and lies at the diſtance of a mile from Wangerland. J. J. Winckelmann ſays, in his Oldenburg chronicle: "In the E. S. E. near this iſland, oyſters were tranſplanted about twenty years ago, and propagated, but they have been reſerved for the ſovereign lord." Winckelmann wrote about the end of the laſt century, but in what year I have not been able to learn.

XI. *Deſcription of Mr.* Collier's *improved Apparatus for Filtering and Sweetening Water and other Fluids.*

THE importance of obtaining pure water for culinary purpoſes is ſo obvious, that any invention for facilitating that object deſerves, and will be ſure to meet with, due attention from the public, as it is a matter that very much concerns their health.

The general practice of paſſing a fluid ſimply through the pores or interſtices of any compact ſubſtance is attended with obvious objections. If the filter is either of animal or vegetable production, it muſt neceſſarily be acted upon by the fluid, which at the ſame time percolates through its own ſediment and corruption. Hence ariſes the neceſſity of frequent change of the filter, which, while it does not altogether remove the evil, is at the ſame time attended with much trouble and expence. If we uſe natural or artificial ſtone, or any other ſubſtance found in the mineral kingdom, the ſediment finds its way into the ſubſtance of the filter, which is thereby rendered extremely foul, and cannot be completely cleanſed by any contrivance hitherto reſorted to for that purpoſe. In percolations through ſand, or any thing in the form of powder, this reaſoning does not completely apply; but in that caſe the powder muſt be often diſplaced to be waſhed or changed. If unconfined, the fluid forms channels for itſelf in various directions; and if confined, as by mechanical force, in a ſtrong box, it is liable to the very objections urged againſt the uſe of compact ſubſtances. The inventor of the machines, of which it is now propoſed to give ſome account, does not pretend to have arrived at the *ne plus*

ultra of improvement in an art of ſo much importance to ſociety as that of purifying water. So far, however, as concerns the difficulty hitherto complained of in the proceſs of filtration, we think he has completely ſucceeded. He has alſo conſulted the only true principles which can ſhorten the extreme tedioufneſs of this proceſs.

Firſt, The groſſer particles and corruption form no obſtruction, as the fluid takes a direction from the exterior of the filter inwards.

Secondly, As the filtering medium compriſes numerous cylinders of ſmall diameters, the contents of which are alſo ſmall compared with their external ſurface, the percolating ſuperficies altogether is as much increaſed as the magnitude of the machine will allow.

Thirdly, As theſe cylinders do not themſelves form the veſſel containing the fluid, but are placed in the veſſel, they ſuſtain a preſſure proportioned to the whole perpendicular height of the fluid within it.

Moreover, it muſt be admitted that the ſubſtance choſen as a percolating medium is free from any poſſible chemical objection, being formed of materials of ſufficient durability, and altogether inſoluble in water and moſt other fluids.

Fig. 1. (Plate IX.) a ſection of a ciſtern of any materials and of any ſize, with a cock A to draw water for common uſe. B, a leaden reſervoir, holding 4, 6, or 8 gallons, placed inſide, the cock C of which comes through and is ſoldered into the ſide of the ciſtern, from which filtered water is drawn off. The bottom of the reſervoir is raiſed about two inches above the lower edge D D of the ſide B, that it may ſtand above the ſediment in the water.—E E are 4, 6, or more hollow cylinders, cloſed at one end, faſtened into the lead, formed of argil and ſilex baked together in a potter's kiln, through which the water percolates into the reſervoir B.—F, a tube a few inches diameter, as high as the ciſtern, with a ſmall aperture at top for the air to eſcape, while its dimenſions anſwer another purpoſe. As water will find its level when the machine has been long at reſt, the water will obtain the ſame altitude in the tube as it ſtands at in the ciſtern; and whenever it is drawn off for common purpoſes, the ſame principle cauſes it to fall in the tube, paſſing inverſely through

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the pores of the cylinders, and producing thereby a reflux as well as a flux, which will always keep the pores free from any obſtruction.

Fig. 2. a ſection of a caſk or tub, contrived, as to the filtering part, preciſely on the ſame principles, but furniſhed with a ſweetening apparatus, which conſiſts of broken crockery placed between two partitions, ſo that the water poured in at the top falls through ſmall apertures upon innumerable ſurfaces; and the caſk being perforated all round at GG, is expoſed to atmoſpheric air, probably ſome hours before it eſcapes drop by drop into the diviſion below.

The reſervoir only differs in ſhape from thoſe contrived for ciſterns, as may be ſeen Fig. 3. which is a horizontal ſection of the caſk Fig. 2.

Fig. 4. a ſection of a caſe lined with lead, and furniſhed inſide with cylinders ſupported on a frame above a ciſtern lined with lead to receive the filtered water. It only differs from the caſk in this reſpect, that the filtering proceſs precedes the ſweetening; the foul water is drawn off at the upper, and the water for uſe at the lower, cock. A funnel or baſon, with a hole in its bottom, is placed within the frame of this apparatus between the caſe and the ciſtern already deſcribed. Through this funnel, which is filled with broken crockery, the water which falls from the caſe is obliged to paſs before it can reach the ciſtern. A vertical ſection of this funnel is repreſented in Fig. 5.

This apparatus is provided with handles and rings deſigned for the convenience of moving, laſhing to a ſhip, &c. The frame is furniſhed with a hanging door on each ſide impannelled with canvaſs, which, while it excludes duſt, admits air, and may be lifted up to examine the ſtate of the ciſtern when neceſſary.

Fig. 6. a longitudinal ſection of one of the cylinders, and a ſeparate view of its bottom, into the ſquare hole of which a tube of box wood enters. The cylinder is fixed by means of a nut and ſcrew, and, with the aſſiſtance of leather, a ſound joint is made to connect it with the leaden bottom of the caſe Fig. 4 and 5.

It would be vain to attempt, by mere mechanical means, to free water from thoſe principles which are held in a ſtate

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of perfect solution; nevertheless it is of great importance, by rendering rain or river water as clear and transparent as hard water (spring water), to preclude in most cases the necessity of using the latter, which generally abounds with pernicious impregnations collected from the bowels of the earth by chemical decomposition.

XII. *A cursory View of some of the late Discoveries in Science.*

[Continued from Page 132.]

BARRUEL has made researches respecting the cause of elasticity, which he ascribes to two principles: 1. "Every body in nature," says he, "is porous, and these pores are proportioned to the density of the substance: 2. These pores are filled with different fluids, and principally with caloric. But caloric possesses a strong repulsive force; from which it follows, that, when an elastic body is compressed, the caloric in its pores drives back by its repulsive power the displaced parts, and brings them to their former state." Libes, who has examined the same subject, makes elasticity to depend on caloric interposed either between the moleculæ of the bodies, or combined with them, and at the same time on the attractive force of these moleculæ. "This being premised," says he, "I say, that the restoration of solid bodies after compression is a combined effect, which depends in part on the repulsive force which their integral moleculæ have received from caloric, and in part from the attractive force of these moleculæ." He then applies elegant formulæ of calculation to these phenomena.

Soquet has made experiments, which seem contrary to those of Count Rumford, respecting the non-conductibility of caloric by fluids. "I have seen," says he, "at Venice a piece of glass, in a state of incandescence, immersed into a pail of water without the latter being reduced to a state of vapour; but, having plunged my naked arm into the water, I found it exceedingly hot. I then approached my hand gently below the mass of glass, and sensibly felt its heat." He admits, however, that fluids in general are not good conductors of

 caloric.

caloric. He then makes ſome reſearches reſpecting the cauſe why the water is not reduced to vapour by incandeſcent glaſs, while it is by incandeſcent iron.

Pictet has given ſome very intereſting obſervations on elaſtic fluids, and aqueous vapour in particular. It appears that all fluids are indebted for their elaſtic ſtate to the matter of fire, or caloric. Some preſerve this elaſtic ſtate at every temperature, and this is the caſe with aqueous vapour. The author endeavoured to determine the quantity of caloric contained in water in a ſtate of vapour at the temperature of ebullition; and experience proved that this aqueous vapour had eight or nine times more caloric than the ſame water in a liquid ſtate at the ſame temperature. The following are the means he employed to obtain this reſult:

Let M be one of the maſſes, and T its temperature; m the other maſs, and t its temperature; the temperature of the mixture will be $= \frac{MT + mt}{M + m}$.

This formula he applied to the following experiment:—He took a balloon, the water in which weighed ſix ounces, and was at the temperature of 13°. He introduced into this water, for five minutes, the vapour of an eolipyle, and the temperature of the water roſe to 49°, that is to ſay, was raiſed 36°, and its weight was increaſed 228 grains. He then endeavoured to diſcover what calorific effect would be produced by 228 grains of boiling water on ſix ounces or 3456 grains of water at the temperature of 130°; that is to ſay, what would be the temperature of the mixture.

By applying the above formula he had $\frac{3456 \times 13 + 228 \times 80}{3456 + 228}$ $= 17° \; 15'$ for the temperature of the mixture. Boiling water then did not produce but $4° \frac{15}{100}$ more heat in ſix ounces of water at the temperature of 13°; while the ſame quantity of water, in a ſtate of vapour, at the temperature of 80°, raiſed the heat 36°. The calorific effect, therefore, of water in vapour is about $8\frac{1}{2}$ times greater than that of the ſame water, boiling. But the volume of the vapour is about 1800 times greater than that of boiling water. There is therefore 212 times more fire in any given volume of boiling water than in

in an equal volume of vapour. The author then makes various applications of theſe principles, but particularly to ſteam-engines, the different degrees of the power of which he determines according to the ſtate of compreſſion of the aqueous vapour.

Perolle has made experiments on the intenſity of ſound in different gaſes, which ſeem to give a reſult contrary to thoſe of Prieſtley, Chladni, and Jacquin jun. Maunoir and Paul, of Geneva, having inſpired hydrogen gas without being incommoded by it, were much ſurpriſed, when they attempted to ſpeak, to find that their voice had become ſhrill and ſqueaking.

Perolle has given experiments alſo reſpecting the propagation of ſound, by which he ſhows that air is not the beſt medium for conveying it. He ſtopped his ears with bits of chewed paper, and, having applied his watch to them, could not hear the noiſe of its beating. He removed the watch, and placed it in contact with a ſmall cylindric piece of wood, the other extremity of which touched one of thoſe external parts of the head that propagate ſound; ſuch, for example, as the cartilaginous parts of the ear; and he then heard the beating of the watch.

He ſuſpended the watch in the middle of a bocal, and found that the ſound reached him; but having filled the bocal with water, the ſound was much ſtronger. The joints of the watch had been luted. He placed the watch on different bodies, ſuch as wood, a marble table, &c. and found that the latter tranſmitted the ſound faintly, while the former tranſmitted it with greater or leſs force. He thence concludes that the ſound of muſical inſtruments, ſuch as violins, harps, harpſichords, &c. depends on the property which wood has of tranſmitting ſounds; and that houſes built of marble or ſtone are leſs ſonorous, becauſe theſe bodies are worſe conductors of ſound.

Lamarck has obſerved that ſounds are tranſmitted in vacuo in water, and through the moſt ſolid bodies. The cannon of Toulon are heard at Monaco, that is to ſay, at the diſtance of more than 25 leagues, while one is lying on the ground; but the ſame ſounds are not propagated nearly ſo far in the air. From this he concludes:

1ſt, That

1ſt, That the common air in which we live is not the proper matter which conducts ſound, ſince, notwithſtanding the great tranſparency of this fluid, it is ſtill too groſs to penetrate freely the maſſes of thoſe bodies which have greater denſity than itſelf; a property which the matter fit for conducting ſound evidently poſſeſſes.

2d, That there exiſts an inviſible, exceedingly ſubtile and ſingularly elaſtic fluid, of extreme rarity, which eaſily penetrates all bodies, which is diffuſed throughout every part of our globe, and conſequently throughout our atmoſphere.

3d, That this fluid is the eſſential cauſe of the elaſticity with which atmoſpheric air ſeems to be endowed, and that it is to the vibrations communicated to this ſubtile fluid—vibrations which are tranſmitted with great celerity through different mediums, and even the moſt ſolid—that we ought to aſcribe the immediate cauſe of ſound and noiſe in regard to us.

4th, That the ſubtile fluid which conſtitutes the propagating matter of ſound is exactly the ſame as the ethereal fire, of which the author ſays he has demonſtrated the exiſtence in his different writings, and which may be conſidered as the ethereal fluid mentioned by Newton, if to its well known properties we do not add the ſuppoſition by which Newton gives to its vibrations a velocity greater than that of light.

Tremery has confirmed the opinion of thoſe who think that electricity is propagated in vacuo. He exhauſted entirely of air the tube of a barometer; and having extracted a ſpark by means of a metallic rod, the electric fluid paſſed in the vacuum, and the whole inſide of the tube became luminous.

ATMOSPHERIC AIR.

Humboldt has publiſhed the reſult of his obſervations on the nature of atmoſpheric air, by which it appears that the purity of this air is ſubject to great variations. The ſum of his obſervations is as follows:—The quantity of oxygen contained in atmoſpheric air decreaſes according to the abundance of clouds, fogs, rain, and ſnow; but it increaſes during

dry

dry and serene weather. After great rain the eudiometer indicates in atmospheric air only 0·264, and 0·259 of oxygen. But when the blue sky appears, the eudiometer marks 0·284 of oxygen, and as far as 0·290. The experiments of Read seem to announce a combination between oxygen and electricity; but we are still ignorant whether the air being charged with the electric matter has any influence on its purity. Buch collected the air of the Gisberg at an elevation of 3890 feet, and Humboldt found this air exceedingly impure. It appeared by the eudiometer that it contained 0·026 less of oxygen than that of the plain; which confirms what we before knew, that the air on high mountains is more impure than that found at a less elevation. The purity of the air varies to such a degree, that the author saw the eudiometer announce, between April and November 1797, from 0·290 of oxygen to 0·236. But, does atmospheric air contain only oxygen, azot, and carbonic acid? The author thinks it probable that it contains also a portion of hydrogen, which combines with the azot, and which we have no means of detecting. Humboldt collected air in the crater of the peak of Teneriffe, at the height of 1904 toises, and found in it only 0·19 of oxygen. It must be observed that there is no longer any eruption from this crater. The pure air of the plain at the bottom of the peak contains 0·278 of oxygen. The air at sea in the latitude of 10° 30′ contained more than 0·30 of oxygen. This observation shows that the air at sea contains more oxygen than that at land *.

METEOROLOGY.

Bouvard continues to make meteorological observations with great accuracy. He has found the variation of the needle at Paris to be 22° 15′, and the dip 70° 35′. Coulomb employs a new process to find the dip of the needle, which at Paris he estimates at 68° 10′.

Humboldt has made interesting observations respecting the magnetic needle. The following is the result of those in

* For other important information connected with this branch, see Dr. Van Mons's letter in our last, and Dr. Girtanner's in our present, Number.

regard

regard to its dip. The magnetic force is meafured by the number of ofcillations which the needle makes in a minute. The inclination is given in degrees of the circle divided into 400 parts.

Places.	Latitude.	Longitude.	Dip.	Magnet. force.
Paris - -	48° 5′ 15″	0° 0′ 0″	77° 15	24·5
Nimes -	43° 30′ 12″	0° 7′ 56″ E	72° 65	24·0
Montpellier	43° 36′ 29″	0° 6′ 10″ E	73° 20	24·5
Marfeilles	43° 17′ 29″	0° 12′ 14″ E	72° 40	24·0
Perpignan	42° 41′ 53″	0° 2′ 14″ E	72° 55	24·8
Barcelona	41° 23′ 8″	0° 0′ 33″ W	71° 80	24·5
Madrid -	40° 25′ 18″	0° 24′ 8″ W	75° 20	24·0
Valencia -	39° 28′ 55″	0° 10′ 4″ W	70° 70	23·5
Ferrol - -	- - - -	- - - -	76° 15	23·7
At Sea -	32° 16′	17° 7′	71° 50	24·0
Ditto - -	26° 51′	19° 3′	67° 20	23·0
Ditto - -	14° 15′	48° 3′	55° 80	23·9
Ditto - -	13° 51′	50° 2′	50° 15	23·4
Ditto - -	10° 59′	64° 31′	46° 50	23·7

He found the variation at Marfeilles on the 11th of November 22° 55′ 30″; at Madrid, in May, 22° 2′; and at Aranjues, about the fame period, 21° 58′. The water of the fea appeared to him to be lefs denfe under the equator than at fome diftance from it.

Buch has given fome refearches refpecting the barometer, in which he examines the caufes of its variations. In his opinion, the ftate of the barometer and its variations do not depend on the ftate of the furface of our globe, and we muft feek for the caufes beyond it. His proofs are:

1ft, That the barometer varies very little under the tropics, and that its variations increafe on approaching the poles. But if thefe variations depended on the ftate of the atmofphere, they ought to be equally perceptible over the whole furface of the globe.

2d, The barometer often remains almoft motionlefs amidft the greateft agitations of the atmofphere. Thus, in 1794, when Vefuvius was in the utmoft agitation, and when the air was filled with the flames, afhes, and fmoke of the volcano, the barometer was almoft motionlefs.

Cotte

Cotte has prefented a view of the fevere winters which we have experienced. A difpute had arifen among the fcientific men at Paris refpecting the cold which would take place in the winter of the year 1798: and fome afferted that it would be fevere becaufe that of 1398 was fo; founding their opinion on this circumftance, that the fame temperature muft take place every four hundred years. Mazuyer maintained, that the fevere winters in our climates take place between the fourth and fifth year, or the eighth and ninth years; becaufe, according to the remark of Toaldo, the feafons and conftitution of the years muft have a period almoft equal to the revolution of the lunar apogeum, which is from eight to nine years, and that, towards the middle of this period, that is to fay, every four or five years, there muft be a return. Thus the fevere winter of 1788-1789 followed one which took place ten years before; and that of 1794-1795 took place four years after that of 1788-1789.

Cotte feems rather to refer to the period of nineteen years, which brings back the moon to the fame points. He eftimates, therefore, that the general temperature of any year ought to correfpond with that of each antecedent nineteenth year after the commencement of the century. But thefe rules he confiders only as probabilities.

Lamarck has publifhed an annuary, in which he endeavours to determine a prognoftication of the temperature from the pofition of the moon in the fouthern or northern figns. When fhe is in the fouthern, it is probable that north and eaft winds will prevail; when fhe is in the northern, it is probable that fouth and eaft winds will be moft prevalent; and thefe winds have a decided influence on the temperature and rain *.

Cotte has given an extract of a memoir, by Beaumé, on thermometers. The motion of thofe made with fpirit of wine is different from thofe made with mercury. Thus, near the degree of boiling water, when the mercurial thermometer falls five degrees, that made with fpirit of wine falls feven; and on the other hand, near the freezing point, when the mercurial thermometer falls five degrees, that made with

* See alfo Toaldo's paper on this fubject, Phil. Mag. Vol. IV. p. 367.

fpirit of wine falls no more than three or four. The mercury dilates from the freezing point to that of boiling water, in the ratio of 5045 to 5122, or of a 65th part of its volume. Mercury in a ftate of ebullition in the open air makes the mercurial thermometer rife to 190 degrees, the barometer being at 28 inches.

GALVANISM.

Jadelot has tranflated into French Humboldt's work on galvanifm, to which he has added a great many of his own experiments. The general confequences he prefents are as follows:

1ft, The effects of galvanifm are for the moft part different in the different parts of animals.

2d, The diaphragm, in warm-blooded animals, is that mufcle which, if not irritated moft ftrongly, is at leaft irritated with the moft readinefs; for it is the only one that always contracts itfelf with the greateft violence in experiments where no chain is formed, but which do not however fucceed unlefs in thofe whofe irritability is greatly exalted. May not this obfervation contribute towards determining the refpective degrees of the irritability of the different mufcles? Thefe experiments atteft:

3d, That, as Humboldt has remarked, the living nerves and mufcles are furrounded with an active and fenfible atmofphere; a condition that, added to the conducting property in which the animal organs participate with all moift fubftances, fupports the explanation of profeffor Reil refpecting the action of the nerves, which extends beyond the points where they difperfe themfelves.

4th, That, as Humboldt obferved alfo, galvanifm may excite movements in the organs altogether independent on the will, as in the heart and ftomach.

5th, That the galvanic fluid, coming from a warm-blooded animal, may act with efficacy on the nerves of the human body.

6th, That the galvanic phenomena take place without the intervention of any external body: that, thus, the caufe which produces them refides in the living animal economy.

7th,

7th, That they can manifeſt themſelves by means of a chain eſtabliſhed between two points of the ſame nerve, and by adduction in organs brought into contact with ſome part of the fleſh.

Vaſſali-Eandi has given intereſting obſervations on galvaniſm. "We do not yet know," ſays he, "what is the cauſe of theſe extraordinary phenomena: Volta is inclined to believe that the muſcular contractions are excited by the electricity which the metals that touch each other, or the heterogeneous bodies that ſerve as conductors, acquire; and that, conſequently, we ſee no animal electricity in the phenomena of galvaniſm; which, according to this theory, proves nothing elſe than that animals are electrometers more ſenſible of the ſmalleſt degree of electricity than other electrometers." The author then relates the experiments of thoſe who aſcribe all theſe phenomena to an electricity peculiar to animals; and he concludes by ſaying—"Were I to declare my opinion, I ſhould be inclined to believe that the muſcular contractions are produced by the movement of animal electricity directed by the conductors of natural electricity." The changes of electricity which different fluids experience in the body, may ſerve to explain theſe phenomena; for he himſelf has proved, for example, that urine when iſſuing has negative electricity, while the blood which flows from a vein has poſitive electricity.

Fabbroni has publiſhed an important work on ſeveral phenomena aſcribed to galvaniſm. Inſtead of aſcribing the effects to electric fire, he is of opinion that they depend on a chemical operation; that is to ſay, an action exerciſed by the two metals on each other. (See *Phil. Mag.* Vol. V. p. 268.)

[To be continued.]

XIII. *On the various Remedies that have been recommended for the Cure of the Hydrophobia.*

WE ſhall not diſtreſs our readers by a painful detail of the ſymptoms and progreſs of this dreadful malady, but content ourſelves with giving ſuch remarks on the various methods of cure as may prove uſeful to mankind.

Sea-bathing was for a long time held to be a fovereign cure, if timeoufly reforted to: the many melancholy failures, however, of this boafted remedy have long fince convinced medical practitioners, that even in thofe cafes where a fuppofed cure had been effected, there had actually been no difeafe; the faliva in fuch cafes having been previoufly cleanfed from the tooth of the animal that inflicted the bite, by paffing through thick clothes before it reached the patient's fkin.

Mercurial frictions, there are reafons for believing, have fometimes proved beneficial in the hydrophobia. Dr. Fothergill feems inclined to afcribe their good effect more to the ingredients with which the mercury is made into an ointment, than to the mercury itfelf: But of this hereafter. Dr. Metée afcribes them to the volatile alkali which the mercury difengages from the ammoniacal falt contained in the lymph of the animals.

The king of Pruffia, in the year 1777, purchafed from a Silefian peafant a remedy for the hydrophobia, which he ordered to be kept prepared in all the apothecaries' fhops, and by all furgeons. The bafis of this remedy is the *meloë profcarabæus et majalis*, (oil-beetle *,) a black unctuous infect, which, when touched, emits from all its articulations a brown oily liquor, and on that account it has been called the oil-beetle. It is found in almoft every country in the fpring. It is called fometimes the farrier's beetle, becaufe the farriers prepare from it a bliftering ointment by pounding three hundred of the infects in a pound of oil of laurel. The following is the method of preparing the anti-hydrophobic remedy of Pruffia:

℞. Take twenty-four beetles preferved in honey, two grains of ebony wood, one grain of Virginian fnake-root, one grain of filings of lead, twenty grains of the mofs of the afh-tree, four ounces of theriac, and a little of the honey in which the infects have been preferved.

The dofe of this opiate varies according to the age and fex of the patients. It is to be taken once in a dofe of two grains for male adults, a grain and a half for females, and a grain

* See *C. T. Schwarts de hydrophobia, ejufque fpecifico Meloë majali et profcarabæo.* Halæ 1783.

for

for children of twelve years of age, diminiſhing the doſe according to the age. Four grains are given to oxen morning and evening, and they are made to faſt twenty-four hours. It is recommended to thoſe who take this remedy, to remain twelve hours in bed in order to excite perſpiration. The patient alſo, during that period, muſt abſtain from food and drink. It is recommended likewiſe, in the obſervations on the Pruſſian cure, to burn the ſhirt which the patient had on while ſubjected to perſpiration. The wounds are to be waſhed with wine and vinegar into which ſalt has been put, and to be afterwards dreſſed with baſilicon or ſalt butter. If this remedy ſucceeds, its effects are to be aſcribed to the *proſcarabæus meloë,* which has the property of cantharides; an inſect which belongs to the ſame genus, and which the celebrated Stoll, profeſſor of medicine at Vienna, and director of one of the hoſpitals in that city, has aſſerted to be a ſpecific in the hydrophobia. His firſt care was to cover the wound with a veſicatory, which he continually renewed. He preſcribed internally tincture of cantharides, at firſt two drops, which he increaſed progreſſively for forty days, according to the age and conſtitution of the patient: the doſe at laſt was carried to twenty-four drops, which may ſeem almoſt incredible. This medicine is the moſt violent diuretic known, and the application of it requires an able hand: but its efficacy is aſſerted to be well eſtabliſhed; as alſo, that it produces the moſt ſalutary effects even when the hydrophobic poiſon has had time to diffuſe itſelf throughout the maſs of the blood. In the laſt ſtages of the diſeaſe, the obſtacle hitherto moſt invincible is the difficulty of making the patient ſwallow any remedy. Every body knows the convulſions and horrid paroxyſms into which the unfortunate ſufferers are thrown merely by the ſight of any liquid. Stoll was of opinion, that the effect of the hydrophobic virus on the ſenſes is directly the reverſe of that of opium: it augments irritability as much as opium lowers it: the leaſt noiſe, the ſmalleſt degree of light, to perſons labouring under this dreadful malady, produces torture beyond deſcription; and the diſſection of bodies, in which no change in the humours or in the organiſation was obſerved, ſeems to prove that this opinion is

well

well founded. If these obstacles, then, were removed, and if the patients could swallow the remedies prescribed for them, there is reason to think that their lives might be saved. Stoll entertained some good ideas on this subject; but want of opportunity, and premature death, prevented him from applying them to practice. He was of opinion, that the excessive irritability, occasioned by the hydrophobic virus, might be overcome by opium; and, as the patients cannot swallow any thing, he proposed administering it in injections. The difficulty here would be, to determine what quantity of opium ought to be employed; but, after proceeding far enough to produce the intended effect, the patient would then be able to swallow the tincture of cantharides; and, as there is no time to lose in such cases, it would be necessary to raise the dose at first to four drops, and to follow up the cure with activity.

If Stoll's idea be correct respecting the action of the hydrophobic virus, the high state of irritability might, we think, be subdued speedily by making the patient inhale *hydro-carbonat*. The idea is certainly worthy of the attention of the faculty; but this gas should not be resorted to except with the aid of a physician. With such aid, however, if a mere reduction of the irritability be all that is necessary to enable the patient to swallow medicines, the end might certainly be gained.

C. Delametherie * informs us, that several eminent physicians, such as Tissot, Lassore, Blais, Belleteste, &c. have employed the volatile alkali with success in the hydrophobia. In the *Gazette de France* of May 4, 1799, there is an extract of a letter from Carmont in Andalusia, dated March 27, the same year, which says, that a shepherd having been bit by a mad dog, and symptoms of the hydrophobia having begun to appear, Don Candido Trigneros, a physician in the neighbourhood, applied to the wound a little lint dipped in volatile alkali, and with the approbation of Don Joseph Mexia, of the Medical and Patriotic Societies of Seville, ordered the patient to swallow, for four days, twelve drops of volatile alkali in three ounces of water; which made the symptoms of madness disappear.

* *Journal de Physique*, Ventose, an. 8.

"I re-

"I received," ſays Delametherie, "a letter dated Auguſt 7, 1778, from M. Noguerez, curé of Paſſy-lès-Paris, in which he gave me an account of the method by which he cured of the hydrophobia a gardener named Olivier, who had been bit in the middle finger by a mad cat. Some days before, a man in the ſame houſe, who was bit by the ſame cat, had ſeveral fits of the hydrophobia, of which he died in the Hôtel-Dieu. It was not till twenty days after the accident happened, that Olivier's ſleep began to be interrupted by violent agitations, during which he was delirious. When awake, his eyes had a haggard appearance. The curé having adminiſtered to him fifteen drops of volatile alkali in a glaſs of water, his patient paid him a viſit next morning, and informed him that he had enjoyed good reſt during the whole night. The curé made him take, for two days longer, ten drops of alkali in a glaſs of water, and ever ſince Olivier has remained in good health. I have employed this remedy with ſucceſs for preventing the hydrophobia."

C. Pelletan, one of the moſt celebrated ſurgeons of Paris, has inſerted in the public papers, that, by cauteriſing the part bit, and afterwards plunging it into cold water, the effects of the hydrophobic virus might be prevented. "This fact," ſays Delametherie, "brings to my remembrance an experiment which a game-keeper of Ile Adam made, ſeveral times ſucceſſively, in the preſence of the late prince of Conti. He cauſed himſelf to be bit in the arm by a mad dog, ſprinkled over the wound ſome gunpowder, and, having ſet fire to it, tied up his arm in a wet cloth. Theſe bites were never attended with any bad conſequences. I was a witneſs to an experiment of the like kind made at Blois by a limonadier, near the bridge. Having been bit in the hand by a mad dog, he immediately burnt ſome gunpowder on the wound, and continued well.—The theory of this important fact is as follows: The burning decompoſes the animal tiſſue, and diſengages volatile alkali, which is circulated with the blood, and neutraliſes the hydrophobic virus. Volatile alkali acts with the greateſt efficacy, and prevents the effects of the hydrophobia. It is ſufficient to put ſome of it on the wound, and

and to uſe it internally after it has been diluted with a conſiderable quantity of water."

The Ormſkirk medicine, from its great celebrity, deſerves ſome notice here; and the more ſo, as we can lay the recipe before the world, which will enable medical men juſtly to appreciate its pretenſions. The quantities of the various ingredients are, to be ſure, rather looſely expreſſed, were accuracy a matter of moment in ſuch a compound: "℞. A ſmall tea-ſpoonful of prepared oyſter-ſhell; one caſe-knife pointful of roach-alum, burnt; one caſe-knife pointful of Armenian bole; as much elecampane root as will lie on a ſilver ſixpence, and the ſame quantity of aſh-coloured ground liverwort—all in powder. They muſt be well mixed together. The doſe for a perſon of the ſtrongeſt conſtitution is two drachms, apothecary's weight, in a glaſs of red port, taken in the morning faſting. The patient muſt faſt for two or three hours after."

The above was ſent to the editor for the purpoſe of being laid before the public through another medium (a newſpaper) ſo far back as the year 1791, but by ſome accident was miſlaid till a few days ago *. The author, after enumerating the virtues aſcribed to the various ingredients by different writers, which we give in a note in his own words †, concludes with the following obſervations:

"What

* It is dated "Biſpham, Lancaſhire, 28th October 1791," and bears the Ormſkirk poſt-mark.—No ſignature.

† "If for a cow, horſe, or pig, give double the quantity, in a pint of milk or water: if for a dog, give the double doſe in a little new churned butter, without ſalt; and take care to tie him up, in a clean place, without litter, as they are ſubject to vomit it up again. The quantity of each ingredient above is rather uncertain, if the conſequence ſignified any thing. The oyſter-ſhells are to be well cleaned, pulveriſed, and levigated into an impalpable powder, which may be dried on a chalk-ſtone, and afterwards ſet by in a warm or very dry place for a few days. The Edinburgh College give the preference to thoſe ſhells which are hollow. This has the virtues of other teſtaceous powders. The alum is to be burnt in an earthen veſſel, or one of iron, as long as it bubbles or ſwells up. The bole is not always found pure; it ſhould be of a bright-red colour, with a tinge of yellow. It will effervеſce with acids; and in order to free it from impurities,

"What degree of confidence ought to be placed on the medicine, muſt be left to the judgment of the diſcerning; as alſo, whether a preference ought not to be given to that grand corrector and blunter of all animal poiſons, OLIVE OIL; eſpecially if camphor is diſſolved in it? We have an account from the continent of its curing the hydrophobia in a very advanced ſtate, when given in large doſes; and we know that it certainly is an effectual cure for the bites of ſerpents, vipers, &c."

From what ſource the author of this letter learnt that the

rities, powder it and waſh it: the finer part may be decanted into another veſſel; the impurities will remain. After the finer parts are ſubſided, pour off the water, and dry the bole for uſe. Bole was formerly much eſteemed as an alexipharmic, and ſingularly ſerviceable in malignant and peſtilential diſeaſes.

"The inula, or elecampane, grows commonly in moiſt places, and is often cultivated in gardens; the flower is a yellowiſh-green, ſomewhat ſimilar to a chryſanthemum, but larger. According to Linnæus, it is the ſecond order of the 19th claſs, *Syngeneſia Polygamia ſuperflua.* The root is here to be uſed only. In the recent ſtate it does not ſmell ſo ſtrong as in the dry; for it then is highly aromatic. The proper time for taking up the root is toward the end of September. The druggiſts have a trick of mixing other ſubſtances with it when it is purchaſed from them in powder. As a medicine, it was formerly in high eſtimation. Rembertus Dodonæi, an eminent German botaniſt, who wrote about 220 years ſince, ſays it is an excellent remedy againſt the bite and ſtings of all venomous animals. Dr. Hill ſays, from his own experience, that an infuſion of the freſh root, ſweetened with honey, is an excellent remedy for the hooping-cough.

"We now come to the liverwort, which ſtands part of the original preſcription, although often omitted. Dr. Mead judged it of that importance as to recommend it, with black pepper, under the title *Pulvis Antilyſſus,* to the College of Phyſicians; and it found a place in the Diſpenſatory. Caninus, liverwort: the leaves are covered with a kind of aſh-coloured mealineſs, leather-like, flat with blunt lobes, targets on the edge aſcending. Dillenius 200, tab 27, fig. 102, calls it *Lichenoides digitatum cinereum Lactucæ foliis ſinuoſis.* It grows common on old cops, heaths, woods, and hedges. Mr. Hudſon calls this genus Liverwort: but, as the Marchantia of Linnæus is commonly known by the name of Liverwort, it is neceſſary to mention this difference in order to avoid miſtakes; for, when once a perſon is acquainted with this Cryptogamia plant, he will not eaſily forget it when he ſees it again. Dr. Withering, of Birmingham, a ſenſible, well informed, and ingenious gentleman, gives this genus the Engliſh appellation of Cupthong."

hydrophobia had actually been cured by the use of olive oil, we know not; but the fact is worthy of the more notice, as the same remedy has lately been recommended by Dr. Fothergill, of Bath *, without knowing the fact, but with a force of reasoning that cannot fail to insure its receiving proper attention. Speaking of oleaginous medicines, the Doctor says: "The ancient remedy against the bite of the viper was long confined to the fat of that reptile, till it was at length discovered that olive oil was equally efficacious; a circumstance since well known to viper-catchers, and confirmed by reiterated experiments. Whether it act by a specific power, or merely by inviscating the poison, or otherwise destroying its activity, matters not; the fact has always appeared to me interesting, and the analogy obvious. Whatever share of success the mercurial ointment may have had in counteracting the canine poison, it has invariably been attributed to the mercury; but I have long suspected it ought rather to have been ascribed to the oily quality of the lard, with which it is compounded, and which constitutes two-thirds of the composition.

"To form a just estimate of the cures attributed to mercury, we must take into the account the other means employed at the same time. Thus M. Baudot, M. Bouteille, and other French practitioners of eminence, unwilling to trust to the above mercurial process alone, expressly order the wound to be first carefully anointed with warm olive oil.

"M. Le Roux and his followers, who rejected mercury, and attributed their success to the antimonial caustic alone, employed nevertheless an ointment, consisting chiefly of fresh butter, to dress the wound †.

"In this and other obstinate diseases of the convulsive kind, the ancients anointed the body with warm oil; a practice too much neglected by modern practitioners.

"Conformable to this idea appears to be Dr. Loof's oleaginous medicine, which now properly comes under consideration. The yolk of egg, though probably destitute of any

* See *Letters and Papers of the Bath and West-of-England Society*, Vol. IX.

† *Mem. de l'Acad.*, Vol. VI.

specific

ſpecific power, yet (as an animal mucilage well adapted to render the oil miſcible with the animal fluids, and alſo to reconcile it to the ſtomach) ſeems a proper addition; nor need there be much exactneſs from an apprehenſion of an over-doſe. A domeſtic remedy ſo ſimple, ſo innocent, and ſo well recommended, is certainly entitled to a full and candid trial in this country.

"That the human body may be thrown into a copious perſpiration by friction with warm olive oil, is a circumſtance unnoticed till lately. The effects of this proceſs, as practiſed at the Smyrna hoſpital, in the prevention and even cure of the plague, in the firſt ſtage of infection, are related by Count Berchtold in his late intereſting tract on that ſubject *; and ſince confirmed by the teſtimony of father Lewis, ſuperintendant of the hoſpital.

"If olive oil, then, be really a preſervative againſt the poiſon of the incenſed viper, and even the peſtilential contagion itſelf, is there not reaſon to ſuſpect that oil and oleaginous ſubſtances may have had a greater ſhare in counteracting the canine poiſon than the votaries of mercury ever imagined?

"It is not pretended, indeed, to be a certain, only a probable remedy, after the hydrophobia has actually commenced; analogy affording only a preſumption, not a proof; nor can its efficacy be fully aſcertained, but by repeated trials and attentive obſervation. As the prevention depends on due management of the wound, this medicine is judiciouſly ordered to be applied externally for ſeveral days. On this, probably, and this alone, ought the main ſtreſs to be laid; yet, to calm the patient's mind, and to ſtrengthen his hopes of ſecurity, it may not be amiſs to give the oil alſo internally, according to the directions. Previous to this plan of treatment, however, the wound ought to be diligently waſhed and cauteriſed.

"If it cure dogs after the infection has taken place, it is a remarkable circumſtance; but ſtill more ſo, if it effect this by throwing them into a *profuſe perſpiration*. This muſt certainly be a miſtake. Dogs, indeed, perſpire copiouſly from

* *Deſcrizione del nuovo rimedio curativo e preſervativo contro la peſte.* See Philoſophical Magazine, Vol. II. p. 256.

the lungs, but aſſuredly never from the ſkin, even in the ſevereſt fox-chace.

"As the gaſtric liquor of a healthy animal has the ſingular property of counteracting animal poiſons taken into the ſtomach, might not this fluid, applied to the envenomed wound, tend to deſtroy the activity of the canine poiſon?

"As the ſaliva differs very little from the gaſtric liquor, may it not, in the act of ſucking out the poiſon, add to the ſecurity by ſubduing any minute remnant lurking at the bottom of the wound?

"Mr. Whitaker, an intelligent member of the Bath Agricultural Society, has juſt now favoured me with the following remarkable fact, which tends to corroborate this opinion:—Two perſons, very nearly related, had the misfortune to be bitten, at the ſame time, by a mad dog. One of them, being bitten in the thumb, immediately ſucked the wound diligently till the blood ceaſed to flow; and, without uſing any other precaution, remained well. The other, whoſe lip had been lacerated by the dog, being diſabled from ſucking out the poiſon, had immediate recourſe to the uſual remedy, ſea-bathing—and with the uſual event. The infection took place; the hydrophobia came on; and death enſued.

"As this ſafe and ſimple method by ſuction requires no medical apparatus, can be inſtantly performed abroad or at home, either by the party or a companion, with little loſs of time or delay of buſineſs, ought it not to be earneſtly recommended to all perſons remote from medical aid, particularly ſhepherds, huſbandmen, and agriculturiſts? Nor need this preliminary ſtep be any hindrance in proſecuting at leiſure the other modes of prevention, which have been conſidered as moſt effectual. Were theſe diligently purſued immediately after every accident of this nature, it is preſumed, the hydrophobia would very rarely, if ever, appear. After the proper precautions, therefore, have been duly obſerved, the patient may be encouraged to baniſh anxiety, and reſt in full aſſurance of his ſafety. He may alſo purſue his uſual manner of living, and frequent cheerful company; abſtaining, however, from every kind of intemperance, or being hurried away by

guſts

gufts of anger, or other ftrong paffions. No internal remedies at this period have been infifted upon, becaufe none feemed neceffary; nor could they, for reafons affigned, add to the fecurity.

"The canine poifon feems to attack the oxygenous principle of the blood, the probable fource of irritability and of life. Hence the depreffed unequal pulfe; the chillinefs of the extremities, accompanied with internal heat; the melancholy afpect; the dejection of fpirits; and the general abfence of fever.

"It appears that the hydrophobia may be confidered as a fpecies of fpafmodic *angina*, produced by fpecific contagion, which exerts its influence, 1ft, on the injured part, and afterwards on the organs of deglutition: 2dly, That the local ftimulus, being propagated to the brain, excites the moving powers of the fyftem into re-action; and hence the convulfive motions which fpeedily exhauft the ftrength, and finally extinguifh the vital principle: 3dly, That profufe bleeding may prove highly injurious: 4thly, That the forcing down large quantities of liquid is a cruel practice, as it cannot but increafe the fpafms, and exafperate the malady.

Indications of Cure.

"The chief indications of cure appear evidently to be the following:—1ft, To diffolve the fatal connection between the injured part and the organ of deglutition. 2dly, To calm the violent fpafms, and foothe the nervous fyftem. 3dly, To fupport the ftrength, and invigorate the whole frame.

"To anfwer the firft of thefe indications, much depends on external means, and clofe attention to the injured part. The moment any darting pains, attended with numbnefs and difcoloration, are perceived, they denote the poifon to be in an active ftate, and that no time ought to be loft in profecuting the moft vigorous meafures.

"The period from the commencement of thefe fymptoms to the approach of the hydrophobia is uncertain, and perhaps rarely exceeds five or fix days. To prevent, therefore, the irritation being propagated to the throat, let the fufpected part be immediately cut out, and the furface of the wound duly

duly cauterifed. If any difficulty of deglutition has already been felt, let a fharp blifter or finapifm be applied to the throat, extending from ear to ear. For, unlefs the morbid impreffion can be obliterated by one yet ftronger, and the natural action of the fympathifing parts fpeedily reftored, there can be but fmall hopes of fuccefs.

" A malady fo rapid in its progrefs, fo intractable by nature, demands Herculean remedies, and warrants a prudent trial of the moft active fubftances with which we are yet acquainted. The atropa belladona, in dofes of four or five grains, has been highly extolled by fome German profeffors; the laurocerafus half grain, and arfenic one-eighth by others. The hyofcyamus niger, in form of extract, given in dofes of 15 or 20 grains, in cafes of fixed melancholy, attended with horrors and obftinate watchings. I have fometimes found very beneficial. It moreover procures fleep and compofure of mind; often where opium fails, or even adds to the inquietude. Now thefe potent remedies, with due caution, may be tried in fucceffion: if they fail, they only fhare the common fate of former antidotes; but if one of them fhould anfwer, it may afford an important addition to our ftock of knowledge.

" 2dly, To affuage the fpafms, and foothe the nervous fyftem.

" To effect this after the hydrophobia has actually appeared, all impediments, and whatever may hurt the acute feelings of the patient, or, by the power of affociation, tend to aggravate his fufferings, muft be firft carefully removed; no dog muft on any account be allowed to enter the room. Not water only, and other liquids; but all glaring colours, and glafs mirrors, muft be kept entirely out of his fight. No loud noife, nor cold air, muft be fuffered to moleft him. Having thus removed impediments, we muft next endeavour to affift nature in alleviating the fpafms and in procuring a lucid interval. If there be any critical evacuation in this difeafe favourable to our views, it muft, I conceive, be that of fweat.

" In the cures recorded by Dr. Nugent and others, in five or fix cafes of the hydrophobia in an advanced ftate, the treatment

treatment was different in each; yet there was one circumſtance common to all, and that was a copious ſweat. Till that appeared, the recovery ſeems to have been doubtful. Nor is the caſe deſcribed by Van Helmont an exception: the patient being plunged in the cold bath till half dead, the cure was attributed to the fright, but ought rather to have been aſcribed to the re-action of the ſyſtem, which, being aided by a warm bed and ſudorific regimen, terminated in a ſalutary ſweat. In a ſubſequent experiment of this kind, equally terrific, no ſweat enſued, and the diſeaſe ſoon proved fatal.

" Sudorifics, indeed, ſeldom produce a copious ſweat, unleſs their operation can be aſſiſted by warm diluting liquors. Hence, perhaps, it is, that muſk, valerian, opium, and other powerful ſudorifics, have ſo often failed. Given merely as antiſpaſmodics, without proper dilution, they ſerve but to flatter hope at the expence of diſappointment; let therefore the following method have a fair trial:

" In a pint of olive oil diſſolve an ounce of camphor: let the entire ſurface of the body be diligently rubbed with this ſolution, made warm, continuing the friction, before a gentle fire, till the whole be expended; after which let the patient be covered with flannel, and put into a warm bed till a copious perſpiration be procured. This may be encouraged by an enema of warm wine-whey, with an addition of volatile alkaline ſpirit, or *eau de luce,* which laſt has long been deemed a noted ſpecific in France.—The part affected, and alſo the neck and ſpine, ought to be well embrocated twice a-day with tepid oil, which, by ſoothing the nerves, may act as a powerful anodyne and antiſpaſmodic: could an entire bath of oil be had, it would be, perhaps, greatly preferable to a common bath of warm water.

" A patient, in conſequence of the poiſon of arſenic, had long ſuffered ſevere pains and convulſive ſpaſms over the whole ſurface of his body, which reſiſted various internal and external remedies, till he was ordered, by M. Bouteille, to be placed, for the ſpace of an hour, at proper intervals, in a bath of warm oil, by which he was ſoon completely cured.

"If music has charms to harmonise the nerves, and soothe the feelings of a melancholy or outrageous maniac, as mentioned on the highest authority, can any cause be assigned why, in a musical age like the present, its powerful influence should not be tried against this dreadful malady? Though its effects on the disease occasioned by the tarantula may have been greatly exaggerated, yet, if what has been confidently asserted of its efficacy against the envenomed bite of the most dangerous serpents, be true, the analogy would afford, at least, a presumptive argument in its favour. But, independent of this, other beneficial effects, in removing the wild ravings in certain fevers, might here be produced *. And it was considered by Clinias, Asclepiades, and Aretæus, as an essential remedy in phrensy, melancholy, and mental derangement.

"In the Memoirs of the Medical Society of Paris, Vol. VI. is an affecting instance of a youth of 12 years old, who died of the hydrophobia. The distressing scene, near the close of the disease, induced the physician to try the effects of music, by playing before him on the guitar. The harmony, even at this late period, we are told, appeased the spasms, and rendered the pulse more calm and regular.

"3dly, To support strength, and restore the energy of the brain.

"To enable the patient to bear up under the unequal conflict, his diet should consist of the most nutritious aliments, chiefly of the solid kind, to which may be added fresh eggs, jellies, and bread soaked in generous wine. If, from his dread of liquids, neither food nor medicine of the fluid kind can be got down, they must be conveyed in the form of medicated baths and enemas; of which the body, being in a parched absorbent state, will imbibe more than is generally imagined. Might not liquids be also safely conveyed into the stomach with a flexible tube, as in cases of suspended animation?

"To restore oxygen to the blood, and invigorate the whole system, vital air, properly modified, may be inhaled into the lungs. Where this cannot be had, as nitrous acid contains it

* See *Medical Journal*, Vols. I. II. and XI.

in

in a loose ſtate, and readily detached, the acid may be diluted with a portion of water, and adminiſtered as above mentioned.

"Should any conſiderable truce to the violent ſymptoms be happily obtained, the return of paroxyſm might poſſibly be obviated by a liberal uſe of Peruvian bark with ſteel, and by repeated oxygenation."

From the variety of facts which we have laid before our readers, it will hardly eſcape notice, that volatile alkali and olive oil appear to be the moſt powerful remedies in this dreadful malady; and that the ſecurity of the patient would be further inſured by the wound being well ſucked, and alſo cicatriſed, without any loſs of time. A. T.

NEW PUBLICATIONS.

Principles of Modern Chemiſtry, ſyſtematically arranged. By Dr. F. C. GREN, *late Profeſſor at Halle, in Saxony. Tranſlated from the German.* Cadell and Davies, 1800. 2 Vols. 946 Pages; with Plates and Tables.

THE better part of the uſeful arts is chemical. An infinite number of the appearances and changes of material nature are governed by chemical laws: the reſearches of chemiſtry conduct to the knowledge of philoſophical truth, and form the mind to philoſophical enlargement, and accuracy of thought, more happily than almoſt any other ſpecies of inveſtigation in which the human intellect can be employed.

Hence are candid attention and encouragement eminently due to every undertaking which ſtrives, either to extend chemical ſcience by new diſcoveries, or to recommend and facilitate its ſtudy by elementary publications aiming at new preciſion, clearneſs, order, fullneſs, and engaging elegance. From the times of Boyle, Digby, Mayow, and Hooke, to thoſe of Hale, Lewis, Prieſtley, Black, and Cavendiſh, the philoſophers of Britain, in ſome meaſure, ſlighted chemiſtry for the ſake of thoſe purſuits in the mechanical philoſophy and the mathematics, in which they muſt be confeſſed to

have been incomparably ardent and ſucceſsful. Our fathers were therefore content, during that period, to accept the Germans, Dutch, and French, for their chemical inſtructors. The French, though not the proper authors of the moſt important diſcoveries in that which is called Modern Chemiſtry, were, however, the firſt to combine, correct, and advance thoſe diſcoveries into one general ſyſtem: and we therefore honour them as our maſters; and have ſubmitted to receive from them, as well a new chemical language, as our favourite elementary chemical books. Even the Germans, though not more fortunate than we in diſcovery, nor more ably inſtructive in academical lectures and the exhibition of experiments, have been lately more forward to publiſh compilations of the facts and principles of chemical ſcience; and we neither deny praiſe to their induſtry, nor reject their aid. Such is the progreſs of chemical diſcovery as to demand the frequent compoſition of new ſyſtems, which ſhall aſſemble facts as they are obſerved, and principles as they are eſtabliſhed. Books thus neceſſary we gladly accept, from whatever quarter and under whatever name. We ſhould wiſh them to be originally in Engliſh, to illuſtrate eſpecially the ſtate of Britiſh ſcience, of Britiſh inveſtigation, of Britiſh arts. But, poſſeſs they the true merits which are to be deſired of ſuch works in general, we ſhall receive them with eager gratitude and reſpect even in tranſlation from a foreign language.

The following abſtract of this work, by Dr. Gren, may perhaps aſſiſt our readers to judge what utilities are likely to reſult from the addition of it to the preſent ſtock of Engliſh chemical literature.

It opens with an introductory ſketch of the hiſtory of chemiſtry. In the *firſt* chapter are explained thoſe more general laws which reſpect alike all the other parts of chemical ſcience, the general nature of the moſt remarkable proceſſes of the laboratory, and the forms and peculiar uſes of thoſe inſtruments which chemiſtry chiefly employs. The chemical hiſtory of the more remarkable gaſes, and of ſome of their proximate compounds, fills the *ſecond* chapter. The general characters of the acids, of the alkalies, and of their neutral compounds, are exhibited in the *third*. The *fourth* traces

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the hiſtory of the earths. In the *fifth* the properties of the different mineral acids are explained with conſiderable minuteneſs of detail. The chemical compoſition of vegetables, their principles immediate and ultimate, with their uſes in the arts, are the ſubjects of the *ſixth* chapter. The *ſeventh* chapter is employed upon animal matters. Fermentation and putrefaction are the ſubjects of the *eighth*. The *ninth* and *tenth* chapters give the chemical hiſtory of bituminous and carbonaceous minerals. The metals are the ſubjects of the *eleventh*. Tables of attractions, ſpecific gravities, weights, meaſures, &c. fill nine articles of an appendix. A copious index concludes the laſt volume. A preface by the tranſlator, and a table of contents, are prefixed at the beginning of the firſt.

Such are the parts, the ſtructure, the exterior form, of this work. Its ſcientific value is not to be diſcovered without a more intimate examination of it.

It traces the general hiſtory of chemiſtry from the ſuppoſed origin of the ſcience, among the ancient Egyptians, to the æra of its laſt great improvement by the creation of the antiphlogiſtic ſyſtem.

In the explanation of the firſt general laws of chemical ſcience, or what may be called the *metaphyſics of chemiſtry*, Dr. Gren teaches, that the attraction, the coheſion, and the expanſion of matter depend upon three diſtinct laws: that matter fills all ſpace, without any intervening vacuity: that it is, however, poſſible for two particles of matter to exiſt together in the ſame ſpace at the ſame time: that thoſe which are called *permanently elaſtic fluids* are not condenſible nor deſtructible by the mere abſtraction of their caloric: that the affinity of compoſition, the ſimple affinity, and the double affinity, are the only diſtinguiſhable modes of chemical attraction: that effervescence is no indication of any great activity of attractive force.

Solution, fuſion, evaporation, diſtillation; the ſubordinate modes of theſe different proceſſes, and the veſſels and implements with which they are uſually performed, he deſcribes with conſiderable accuracy and clearneſs.

Concerning *caloric*, this ingenious chemiſt teaches, that

it is elaſtic and *expanſible*: that it is *not expanſible* *: that any quantity of this ſubſtance poſſeſſes more or leſs of expanſive power, according as it is leſs or more expanded: that it fills all ſpace, in continuity, without interſtices: that it never produces ſenſible heat without entering into intimate chemical combination with all the parts of the heated body: that its expanſive force is ſometimes active, ſometimes inert and quieſcent: that, in vapour, caloric is, though fixed and latent, yet only mechanically adherent to the vaporified ſubſtance; while in the permanent elaſtic gaſes it is chemically combined with the reſpective baſes: with various other doctrines, which, as leſs novel and peculiar, require not to be here particularly noticed.

Light, this author repreſents as a compound of a peculiar baſe with caloric. He ſuppoſes it to be rendered fluid and elaſtic by caloric; to be fixed, without it. He conceives light to exiſt in a fixed ſtate in all combuſtible bodies, and to be evolved, in combuſtion, into combination with the caloric from the vital air that is then decompoſed. In this manner he deſcribes *light* as the ſame thing with the *phlogiſton* of the diſciples of Stahl; not allowing that, if fixed, it muſt have gravity, and that, if it have gravity, the bodies out of which it is evolved muſt be lighter, as to their other matter, after they have loſt it, than while it ſtill exiſted in them. He regards it as being, though a diſtinct ſubſtance from caloric, yet the *matter of heat*, and the *principle of combuſtion*.

Speaking of *combuſtion*, Gren ſcruples not to affirm, that the *antiphlogiſtic ſyſtem* affords no explanation of the reaſon, why a certain degree of previous heat is neceſſary to the commencement of flaming combuſtion. *Flame* he deſcribes as eſſentially conſiſting of the burning gas of the bodies which are decompoſed under it.

He thinks it not improbable that gas-azot and gas-oxygen may co-exiſt in the atmoſphere, not in a merely mechanical mixture, but even in intimate chemical combination.

That *fog* which renders the atmoſphere thick, dim, and

* See the work, Vol. I. § 151. It is poſſible, however, there may be ſome miſtake in the printing.

turbid,

turbid, is regarded by Dr. Gren as the basis of aqueous vapour entirely deprived of its caloric.

Dr. Gren regards that which has been called the *oxygenated muriatic acid*, as being nothing but the proper muriatic acid in its full energy. To that which is now commonly called the *muriatic acid*, he gives the name of *muriatous acid*; regarding it as analogous in its character to the sulphureous and the nitrous acids.

He rejects, after Doerffurd, the peculiar existence of the *camphoric acid*. He considers the *narcotic matter* of certain vegetables as worthy to be distinguished as one of their peculiar immediate principles.

The *lithic acid* does not appear to this author to be one that is formed by the organic functions of animals.

He affirms, that those which are called the *acetous* and the *acetic* acids differ only in the degrees of their concentration, not in the proportions of their principles.

His general account of the acids, alkalies, and earths, is indeed brief, and rather incomplete, but in almost every particular sufficiently correct.

According to *our personal* experience, hot lime and sulphur, coming into intimate contact, are apt to exhibit a combustion of the sulphur, from which ensues a formation of sulphureous acid. Dr. Gren recommends, to prepare sulphuret of lime by mixing chalk with sulphur, and then igniting the mixture, to expel the carbonic acid!

In his account of vegetables, Dr. Gren relates, contrary to the experience of other chemists, that *pyro-ligneous acid*, when sufficiently pure, is, in the nature and proportions of its principles, precisely the same with *acetic acid!*

He ascribes to the mechanical porosity alone, of charcoal, unassisted by any chemical re-agency, that power of purifying saline leys from colouring matters which charcoal is well known to possess.

From accurate analyses of *wheat*, able chemists have resolved this substance into the two immediate principles of *farina* and *gluten*; but Dr. Gren rather considers it as composed of *gluten*, *starch*, and *mucilage*.

He denies that any vegetables have in them such an immediate

mediate principle as *aroma*; but ſuppoſes that which has been hitherto called aroma, to be merely volatile or ethereal oil.

The plates of the chemical apparatus at the end of the firſt volume are very beautifully engraved by Mr. Lowry.

Dr. Gren diſcovers no analogy between the gelly of animal bodies and the gluten of vegetables.

He maintains, that, in *bread*, flour is ſo thoroughly, ſo entirely altered, as to be no longer capable of affording even the ſmalleſt portion of farina or gluten.

He reckons no ſubſtances to be properly ſuſceptible of *putrefaction*, ſave ſuch as contain *azot.*

Of *bitumens* he aſſerts, that they muſt *neceſſarily* have had their origin from the decompoſition of animal bodies.

Though more ample in his accounts of the metals than in the preceding departments of his work, he gives no account of the new Corniſh metal the *menachanite.*

At the end the editor has given ſeveral uſeful tables.

As to the other matters in the compoſition of this work, they differ not materially from the explanations in the ſyſtems of Fourcroy, Chaptal, Nicholſon, and Jacquin.

The tranſlation is not free from Germaniſms; but in books of chemical and phyſical ſcience, elegance and propriety of this ſort are rarely regarded as objects of primary concern.

On the whole, we cannot doubt but the public muſt receive, with partial favour, a work of ſuch ſingular merits. The tranſlator, and thoſe who have encouraged the tranſlation, evidently deſerve the warmeſt thanks of Britiſh chemiſts.

Eſſays on the Venereal Diſeaſe. Part II. *By* WILLIAM BLAIR, *A.M.F.M.S. &c. &c. &c.* Symonds, Paternoſter Row. 1800.

IT was ſome time ſince ſtated by Mr. Scott of Bombay, that he had diſcovered the acid of nitre to poſſeſs the powers of a ſpecific remedy for the venereal diſeaſe. Dr. Beddoes, Mr. Cruickſhank, and other medical gentlemen in this country, eagerly repeated the trials indicated by Mr. Scott. The ſucceſs was various. One party affirmed the deciſive efficacy of the new medicine; another declared, from alleged experience,

rience, that its powers were imaginary, or at beſt uncertain. Inaccuracy of obſervation and experiment, with the influence of perſonal partialities and preconceived opinions, were naturally ſuppoſed to be the chief cauſes of theſe contrarieties of report. Mr. Blair, Surgeon to the Lock Hoſpital and Aſylum, therefore, undertook to collect ſuch a ſyſtem of evidence concerning the action of nitric and nitrous acid in *lues venerea*, as ſhould, if poſſible, finally aſcertain the true practical principle in regard to its uſe. The reſult of his firſt inquiries was made public in a former *part* of the preſent work. In the *ſecond part* the ingenious author preſents a multiplicity of new teſtimonies; analyſes and examines the facts publiſhed on the ſame ſubject by others; and endeavours to deduce thoſe general truths, to eſtabliſh which, he conceives that all his aſſembled teſtimonies combine their force. His inquiry has been conducted, and his laſt inferences are deduced, with the candour of a gentleman and the cautious diſcrimination of a philoſopher. "That the acids of nitre, &c. though very uſeful auxiliaries to mercury in the cure of the venereal diſeaſe, are, in no modification of that complaint, to be confidently and excluſively ſubſtituted inſtead of mercury," is the general practical poſition with which Mr. Blair cloſes his whole inveſtigation.

This opinion is, perhaps, the ſafeſt to be at preſent acted upon in medical practice. It ſeems to be allowed on all hands, however, that nitric acid, taken together with mercury, counteracts its debilitating effects without diminiſhing its remedial energy.

Of the ratio of the operation of either mercury or nitric acid, as an anti-venereal remedy, no very particular account has ever yet been given. It has indeed been conceived, that, ſince oxygen is the baſis of *vital air*, it muſt be, in all its various modifications, of ſovereign efficacy for the cure of diſeaſe and the nouriſhment of life; that nitric acid is a remedy againſt *lues venerea*, on account of the oxygen which it contains; and that other oxygenous compounds may probably act with ſimilar effects. All beyond this is ſtill left in myſtery. But, is not the venereal virus one of thoſe innumerable and ſubtle chemical compounds as yet inimitable by

human

human art, which the healthful functions of the animal economy continually form by the endlessly varied combination of hydrogen, carbon, oxygen, and azot? Is not this virus, thus compounded, decomposable, probably, by the affinities of many acid and saline substances, provided these substances might be brought into mixture with it in all those parts of the system in which it is active, and without being themselves previously altered by decomposition or new combinations? Are not the activity with which mercury penetrates throughout the whole body, and that remarkable degree in which, in every one of its combinations, it preserves its primitive energies—are not these the causes of its being a specific for the decomposition and entire expulsion of the venereal virus? Does it not then *certainly* appear, if *oxygen*, or perhaps nitric acid, without decomposition, without new combination, might be brought in sufficient quantity, and for a sufficient length of time, into mixture with all the venereal virus that is at any time in the system, that the virus might be entirely decomposed, and the disease completely healed?

INTELLIGENCE,

AND

MISCELLANEOUS ARTICLES.

PRIZE QUESTIONS.

THE Electoral Jablonsky Society of the Sciences at Leipsic has announced the following prize questions for the year 1800:

History.—A short sketch of the history of the trade of Poland.

Mathematics.—An historical view, quoting the authorities of the various purposes to which the laws of attraction have been applied since the time of Newton to the present period.

Physical Economy.—Of the influence of the atmosphere on

on the fertility of the earth, according to the neweſt and moſt authentic experiments; and in particular, How does the nature of the ſoil, ſituation, and culture, contribute to render this influence active and efficacious? The prize is a medal of the value of 24 ducats; and the papers, written either in the Latin or French language, muſt be tranſmitted, with a ſealed note containing the author's name and place of abode, to C. F. Hindenburg, public profeſſor of natural philoſophy and ſecretary to the ſociety.

The following prize queſtions have been propoſed by the French National Inſtitute.

CLASS OF THE MATHEMATICAL AND PHYSICAL SCIENCES.

I. The Claſs propoſed, for the ſecond time, in the year 6, as the ſubject of a prize, an anatomical compariſon of the liver in different kinds of animals; but as no paper has been tranſmitted on that queſtion, the Claſs has thought proper to withdraw it, and to propoſe the following:

"To determine, by chemical and anatomical obſervations and experiments, what are the phenomena of the torpor which certain animals, ſuch as the marmot, dormouſe, &c. experience, during winter, in regard to the circulation of the blood, reſpiration, and irritability: to make reſearches reſpecting the cauſe of this ſleep, and why it is peculiar to theſe animals."

The competitors are requeſted to examine in particular what differences are obſerved between theſe animals in their lethargic and their ordinary ſtate, in regard to the quickneſs of their pulſe; the degree of the warmth of the blood; the frequency of their reſpiration; the quantity of oxygen conſumed in a given time; and their excitability by galvaniſm. They will examine alſo the anatomical differences which diſtinguiſh theſe animals from thoſe not ſubject to torpor during the winter; and they will endeavour to diſcover whether theſe differences are ſufficient to explain the phenomena of that torpor.

The prize will be a gold medal of the value of a kilogramme. As the experiments reſpecting this queſtion can-

not be made but in winter, the memoirs will be received till the 15th of Meſſidor, year 10. The Inſtitute will proclaim the piece which ſhall be thought worthy of the prize in its public ſitting of Vendemiaire, year 11.

II. The Claſs propoſed alſo in the year 6, as the ſubject of a prize, to be determined in the public ſitting of Germinal, year 8, the following queſtion:

"To endeavour to aſcertain, by accurate experiments, what influence atmoſpheric air, light, water, and earth, have on vegetation."

Though no memoir has been received on this intereſting queſtion, the Claſs has thought proper to propoſe it again; but as the different labours neceſſary to reſolve it completely would require many experiments and conſiderable time; and as it can hardly be expected that all the information which may be wiſhed for can be obtained from the competitors in the courſe of the new term propoſed, the Claſs has decreed, that if memoirs in which the queſtion is treated in its full extent be not received, it will grant the prize to that which ſhall contain a ſeries of experiments, facts, and obſervations, that ſhall appear calculated to augment the knowledge already acquired in regard to ſome parts of the queſtion.

The prize will be a medal of the value of a kilogramme, and will be decreed in the public ſitting of the 15th of Meſſidor, year 10. The papers muſt be ſent in before the 1ſt of Nivoſe, year 10.

III. "What are the characters which diſtinguiſh in animal and vegetable ſubſtances thoſe which ſerve as ferment, from thoſe in which they produce fermentation?"

The prize will be a gold medal of the value of a kilogramme, and will be decreed in the public ſitting of the 15th of Germinal, year 10. The papers muſt be ſent in before the 1ſt of Nivoſe the ſame year.

CLASS OF LITERATURE AND THE FINE ARTS.

"To analyſe the relation which ſubſiſts between muſic and declamation."

"To determine the means of applying declamation to muſic without injuring melody."

The

The prize will be a gold medal of the value of a kilogramme, and will be decreed in the public fitting of the 15th of Nivofe, year 10. The papers muft be written in French, and fent in before the 1ft of Vendemiaire the fame year.

In the fitting of the 15th of Germinal (April 4), at which Bonaparte fat as prefident, C. Cuvier read an account of the labours of the Mathematical and Phyfical Clafs during the preceding three months.

It is in the department of natural hiftory in particular that the labours of the Clafs, during the laft quarter, have enlarged the boundaries of fcience. It has treated fome queftions of the utmoft importance in regard to the hiftory of minerals and that of animals.

Philofophers, for example, have long been embarraffed with volcanoes, on account of the difficulties which occur in explaining the phenomena of them, and in the attempts made to difcover the fources of thofe immenfe quantities of fubftances of every kind thrown up by them during eruptions. C. Patrin, on this fubject, has given fome views which difplay a bold imagination, and has called in to his aid all the refources of modern chemiftry. He fuppofes that the water of the fea is continually attracted between the ftrata of fchift, which generally forms the bafis of volcanoes: that the marine falt is there decompofed: that its acid becomes furcharged with oxygen by paffing over the oxyds of iron and manganefe: that it decompofes the fulfures of iron, and even the water, by the intervention of carbon: that the different products of thefe decompofitions, combining under other forms, give petroleum and hydrogen gas, which take fire, and produce the moft brilliant part of the volcanic phenomena; while electricity, joining itfelf to thefe elements, already fo numerous, forms fulphur and phofphorus. It is the laft-mentioned fubftance above all, which, in the opinion of C. Patrin, acts the moft diftinguifhed part. By it he fuppofes the oxygen is fixed under an earthy appearance, and confequently, it is by it that volcanoes are enabled to furnifh that immenfe quantity of lava which they are continually pouring forth on the furrounding diftricts without exhaufting

the baſe that ſupports them. In the laſt place, the iron is carried into the lava by a metalliferous fluid, to which C. Patrin aſcribes the property of holding metals in a ſtate of vapour, and of depoſiting them under certain circumſtances, almoſt as fluoric acid gas does ſiliceous earth.

Snow of a very bright red colour has ſometimes been found on the ſummits of the higheſt mountains. The matter which colours it, burns with a ſmell ſimilar to that of a great many vegetable ſubſtances. Sauſſure, who often collected ſuch ſnow on the Alps, was induced by this property, as well as by its being found in ſummer, and in places where a great many plants were in flower, to conſider the colouring matter as the farina of ſome plant *. C. Ramond, who found this duſt on the ſnow of the Pyrenees, having remarked that it is heavier than water, ſuſpected it to be of mineral origin; and he, indeed, found that it ariſes from a decompoſition of certain micas. This decompoſition requires, without doubt, the conditions mentioned by Sauſſure; for C. Ramond found that they are neceſſary to the Pyrenees as well as to the Alps.

The production of native metals in the interior of mines is one of thoſe objects alſo which have attracted the attention of naturaliſts, and which have given riſe to a multitude of ſyſtems. An experiment of C. Gillet-Laumont points out one of the ways in which this production may take place. He has ſhown us, that by touching or rubbing with zinc or with iron the muriat of ſilver, that is to ſay, a combination of the oxyd of ſilver with the muriatic acid, the ſilver immediately reſumes its purity and luſtre by giving up its acid to the metal which touches it. But the circumſtances neceſſary for this reduction, which chemiſtry eaſily explains, may occur every moment in the interior of mines.

We too often accuſe the ancients of error when we do not underſtand them. Ariſtotle ſpeaks of the aſpalax as an animal entirely blind. The Romans and the moderns, having tranſlated the word *aſpalax* mole, thought themſelves autho-

* For an account of Mr. Sauſſure's diſcovery of red ſnow on the Alps, ſee the Philoſophical Magazine, Vol. III. p. 168.

riſed

rifed to deny the affertion of Ariftotle; and indeed the mole is not blind; it is alfo an animal different from the afpalax. C. Olivier has brought us from the Levant an animal actually blind, its fkin not being even pierced at the place where the eyes ought to be; which lives under ground like the mole, and which has all the characters afcribed by Ariftotle to the afpalax. This animal is that known to zoologifts under the name of *mus typhlus* and *zemni.*

C. Olivier has given us alfo fome information refpecting another fmall animal known to the ancients under the name of the *two-footed rat,* and to the moderns by that of the *jerboa.* The very fingular conformation of its feet, of which thofe behind are five or fix times longer than thofe before, has been known for fome time, but we had no accurate knowledge of the manner in which it walks. C. Olivier informs us that it moves forwards only by jumping, but that it always falls on all four. He has defcribed alfo the organifation of its genitals, which are armed with fmall points, that muft render its copulation ftill more painful than that of cats. He has defcribed alfo a fmall fpecies of this genus, hitherto imperfectly known.

C. Beauvois has invented an inftrument for indicating the refpective proportions of the crania of different quadrupeds. He has applied it to two animals of North America, which fome naturalifts ftill hefitate to make diftinct fpecies on account of their great refemblance to animals analogous to them in the old continent. Thefe animals are the fox and the rabbit of the United States. The refult of C. Beauvois' comparifons is, that they are two diftinct fpecies; and this opinion is juftified by the habits of thefe animals. The rabbit, in particular, does not burrow like ours, but neftles in hollow trees.

C. Latreille has prefented two memoirs, which have been fince printed. The firft treats of the ferpents of France. Thefe animals, which occafion fo much terror to the vulgar, have not been fufficiently ftudied by naturalifts. The eleven fpecies found in France have often been confounded with each other, but C. Latreille has completely explained the nomenclature.

The

The ſecond memoir relates to ſalamanders, to which our anceſtors aſcribed the property of reſiſting the flames; but they have ſhown to our cotemporaries a property more authentic, and equally wonderful, that of reproducing their limbs when they have been cut off. C. Latreille has deſcribed ſix ſpecies which hitherto have not been diſtinguiſhed by naturaliſts.

Every body knows ultramarine, that valuable colour, which alone imitates the azure of the heavens. It is extracted from a ſtone named *lapis lazuli*, by a very tedious manipulation; and though it has been known for a long time, and was even employed in the middle ages for thoſe miniatures with which manuſcripts were ornamented, no preciſe idea was entertained reſpecting its colouring principle: it was long believed that it was copper. Margraf proved that it is iron; but the queſtion was, to find in what ſtate it exiſts in the ſtone, and how it produces that beautiful blue colour without being combined with the acid of Pruſſian blue. C. Guyton, treating gypſum which contained abundance of iron, remarked that, in changing itſelf into a ſulfure, that matter aſſumed a blue colour as unalterable as that of *lapis lazuli*, and preſerving itſelf even in pot-aſh in fuſion. Guided by this phenomenon, he treated *lapis lazuli* itſelf; and his experiments leave him no doubt that the colouring principle of that ſtone is a blue ſulfure of iron, which has hitherto eluded the reſearches of chemiſts, becauſe they confounded the products of it with thoſe of the grains of pyrites or yellow ſulfure of iron, which exiſt in every kind of *lapis lazuli*. By a few ſteps more the arts will perhaps be enriched with a rare ſubſtance, which may be formed at pleaſure.

C. Chauſſier has rendered an important ſervice to all thoſe ſciences the object of which is organiſed bodies, by communicating the means of preſerving to the different parts of the human body, and of thoſe of animals, the forms which they poſſeſſed when in the ſtate of life. This proceſs conſiſts in keeping them for ſome time in a ſolution of the oxygenated muriat of mercury, commonly called *corroſive ſublimate*. When ſuffered to dry, after being taken from this mixture, they aſſume a conſiſtence like that of wood, and become abſolutely

absolutely unchangeable in the air. If the bodies have been injected before being immersed, they even retain the colour and freshness of life, and consequently form mummies much more perfect than those of Egypt, which, as has been said, only eternised the image of death. C. Chaussier has no doubt that this was the method employed by Ruisch, and which anatomists in vain attempted to discover.

C. Vauquelin and C. Buniva have analysed the liquor of the amnios of woman and that of the cow, together with the substance found on the bodies of new-born children. The liquor of the amnios of woman contains albumen, soda, muriat of soda, and phosphat of lime. The crust on the body of the fœtus is a degeneration of the albuminous substance, which begins to pass to the state of a fat body. The liquor of the amnios of the cow exhibited a peculiar animal matter, a new acid, and sulphat of soda.

Medicine has produced four important memoirs. The epidemic disease which broke out at Nice and Grenoble alarmed the public, and a report was even spread that it was actually the plague. C. Desessart, however, after collecting every information on the subject, has shown that it was only that disease long known under the name of the *jail fever*, which too often attacks armies and other bodies of men when crowded together.

Children are born sometimes with a portion of the viscera uncovered, and having a tumor which by medical men is called an *umbilical hernia*. C. Lassus has shown that the cause of this defect is, that the liver, receiving a larger quantity of blood than it ought by the umbilical vein, dilates itself more than usual, separates the muscles of the abdomen which kept it in its place, dilates and renders thin the tendinous substance that separates them, and makes its way through the same opening of the skin through which the umbilical cord passes. This disorganisation sometimes proceeds so far that the intestines, and even the heart and lungs, are also uncovered. This vicious conformation proves almost always mortal; and C. Lassus announces this circumstance, that surgeons may save themselves the trouble of performing operations, which may cause the parents to be accused of

 ignorance

ignorance or cruelty. C. Pelletan, on the other hand, endeavours to encourage them to undertake another operation, which may be uſeful, and which miſplaced timidity often prevents from being practiſed; it is that of *bronchotomy*, or opening the tracheal artery. Whenever any body capable of ſtopping reſpiration is introduced into that canal, it may be boldly opened, in order to get rid of it.

C. Portal has revived the ideas, which he announced in 1782, on the treatment of that kind of apoplexy called *ſerous*, that is to ſay, of that kind during which the face remains pale and livid. He has proved that emetics, generally adminiſtered in ſuch caſes, are the more inefficacious, as in every kind of apoplexy the ſtomach is palſied; and that, beſides, it has appeared by all bodies which have been opened, that in the ſerous apoplexy, as well as in others, there are accumulations of blood in the brain. He does not heſitate, therefore, to recommend bleeding for the one as well as for the other; and he has proved by practical obſervations that it has often ſucceeded.

C. Duhamel has been employed in improving the art of aſſaying ſilver, or of ſeparating it from the lead it contains. For this proceſs, on a ſmall ſcale, refiners employ ſmall cups of well lixiviated bone-aſhes called *cupells*, which abſorb the lead as it vitrifies, and leave the ſilver pure: on a large ſcale they employ cupells formed of wood-aſhes; but, beſides their being expenſive, they are attended with ſeveral inconveniences. C. Duhamel, after remarking that the litharge, or glaſs of lead, may be ſeparated in proportion as it is formed, without cauſing it to be abſorbed by the cupells, propoſes that theſe veſſels ſhould be made of founders ſand mixed with clay; that the ſurface of them ſhould be covered with a ſtratum of aſhes; that the blaſt of the bellows ſhould be directed on the fluid lead to accelerate the oxydation; and that the litharge ſhould be made to run off by a groove formed in the edge of the cupell, and which ought to be dug lower in proportion as the bath ſinks down.

C. Lacepede read an ingenious memoir on ſome phenomena reſpecting the flight and viſion of birds. He took, as the object of his obſervations, the eagle and man-of-war

bird;

bird; two kinds which are endowed with the ſtrongeſt power of flight and the acuteſt viſion. It reſults from his obſervations that the ſight of theſe birds is nine times more extenſive than that of the furtheſt ſighted man; and that in 220 hours, that is to ſay, in a little more than nine days, allowing them 16 or 17 hours of repoſe, they would make the tour of the whole earth.

C. Cuvier read the eloge of Daubenton, with an account of his labours, in the courſe of which he drew a parallel between him and his friend Buffon. Buffon always ſuffered himſelf to be led away by his imagination, Daubenton always endeavoured to guard againſt his: the former was full of vivacity, the latter of patience: the firſt choſe rather to gueſs at the truth than to obſerve it; the ſecond remarked all its details, and was always diffident of himſelf.

The Claſs has received from ſeveral of its members the following works:

C. Olivier has preſented the three firſt volumes of his Natural Hiſtory of Inſects, which contain a deſcription and figures of an immenſe number of new and intereſting ſpecies.

C. Briſſon preſented a new edition of his *Dictionnaire de Phyſique*, with additions containing an account of all the modern diſcoveries.

C. Cuvier has preſented the two firſt volumes of his Leſſons of comparative Anatomy. In this work the author examines the organs of motion and ſenſation in regard to their ſtructure and uſes in man and all the other claſſes of animals.

C. Leveſque read at the ſame time an account of the labours of the Claſs of the Moral and Political Sciences during the preceding three months.

C. Goſſelin has examined the geographical knowledge of the ancients reſpecting the ſouthern coaſts of Arabia. He has proved that Ptolemy, notwithſtanding the ſingular form he has given to them, has preſerved with the greateſt accuracy all the diſtances, and that our beſt modern charts might be corrected by the labours of that ancient geographer.

C. Buache has communicated to the Claſs a memoir, in manuſcript, written at Cairo in 1717 by the French traveller Paul Lucas. This memoir contains ſome curious information

tion reſpecting ſeveral places in the interior of Africa. The means employed by Paul Lucas to obtain this information were the ſame as thoſe employed by ſome late Engliſh travellers: he conſulted the caravans which ſet out every year from Cairo for Africa.

C. Langles, by his ſkill in oriental literature, has been able to procure ſome information, which he has communicated to the Claſs, reſpecting a people in India called the Seeks. Theſe people, whoſe capital is Lahor, acknowledge as their founder a Hindu born in 1469, who gave them in one book their code of laws and the ritual of their religion. They adore one God, to whom they aſcribe neither paſſions nor human weakneſs. As they are ſtrangers to the ſhackles of ſuperſtition, they have not received thoſe of deſpotiſm, which, by oppreſſing the other tribes of India, enchains their courage as well as their ideas. As they are induſtrious, opulent, and brave, and are protected by natural ramparts impenetrable to cavalry, they have never yet been ſubdued even by the Mogul princes, their neighbours.

ELECTORAL ACADEMY OF THE USEFUL SCIENCES AT ERFURT.

In the ſitting of September 2, 1799, A. F. Hecker read a treatiſe on the care and education of orphans; on hoſpitals for foundlings, and on child-murder.

J. J. Bellermann communicated ſome obſervations on five oriental manuſcripts which had been preſented to the Academy.

C. Cramp communicated his analyſis of aſtronomical and terreſtrial refractions.

In the ſitting of October 2, Charles Theodore Anthony Maria Baron von Dalberg read a paper on ſteatites, and the uſes to which it may be applied in the arts by lapidaries; and communicated at the ſame time ſome obſervations which he had made on the ſteatites of Baireuth (*talcum ſteatites*). Steatites is an exceedingly ſoft ſtone, which can be cut or turned with great eaſe, and which, when burnt in a cloſe veſſel, acquires ſuch a hardneſs as to withſtand the file. In this manner an artiſt, with very little expence, might prepare

7 cameos,

cameos, gems, and ſmall toys, which in point of ſolidity would not be inferior to thoſe of the ancients. The author made a ſeries of experiments on the method of giving a durable dye to hardened ſteatites, by which it appears that it may be made to imitate the moſt eſteemed and moſt beautiful kinds of ſtone. In the ſpecimens of the coloured ſteatites laid before the Society, ſome of which had heads cut on them, the members admired in particular the high degree of poliſh of which burnt ſteatites is ſuſceptible, and in which it exceeds even agate. Theſe experiments are curious, and of the utmoſt importance to the arts.

Profeſſor J. Bartholomew Trommſdorf gave at the ſame time a chemical analyſis of ſteatites, by which it appears that ſiliceous earth and talcky earth are the principal component parts of this foſſil. The profeſſor, however, obſerved alſo a ſmall mixture of argillaceous earth, which Klaproth, during his reſearches, did not find, but which, according to the author, was perhaps accidental.

Prince Demitri von Gallitzin gave an account of the experiments which he made with different kinds of air in regard to the germination of vegetables. He ſowed garden-creſſes in thirteen kinds of air, and kept them all at an equal temperature. The following were the reſults:—1ſt, In oxygen gas, and in air corrupted by reſpiration and burnt bodies, germination took place as well as in common air. 2d, In hydrogen gas and in carbonic acid gas, extracted from different bodies, and by various proceſſes, there was no germination. The ſeeds of the creſſes ſwelled up a little, but in the courſe of eight days there was not the ſmalleſt ſign of growth; though the ſeeds in atmoſpheric and oxygen air, and air corrupted by reſpiration, produced in the ſame period four leaves. Atmoſpheric air being admitted into the glaſſes which contained the carbonic acid, and hydrogen gaſes, the ſeeds in forty-eight hours threw out two leaves. From this it ſeems to follow, that carbonic acid and hydrogen gaſes check and retard germination, but do not deſtroy it. 3d, Nitrous air deſtroyed the ſeeds, gave them a black colour, and rendered them incapable of germinating in other kinds of air.

This effect, as the author conjectures, arifes from the nitrous acid which the nitrous air contains. The author communicated alfo the following obfervation:—Being defirous, as the late Camper was, to difcover fome means for preventing potatoes from growing, in order that they might be preferved in a ftate fit for food throughout the whole year, he put fixty of them into a glafs bell with fixed air, and clofed the aperture with mercury. The potatoes, indeed, did not germinate, but at the end of fix months they were totally fpoiled, emitted a brown corrupted juice, and ftunk moft intolerably.

Dr. G. H. Thilow read a paper on the action which purified nitre and common falt have on the animal body. From feveral experiments which the author made in the galvanic manner, with many variations, on different animals, he concludes, that nitre poffeffes the property of lowering the tone of the nervous and mufcular fibres. Thus, for example, the crural nerve of a frog being ftrewed over with nitre, no convulfive movements of importance took place; but when common falt was applied in the fame manner, exceedingly violent convulfions were produced. The author is therefore of opinion, that common falt is to be confidered as one of the ftrongeft of ftimulants.

In the fitting of November 2, J. F. H. Baron von Dalberg prefented a treatife on the origin of harmony, and its progreffive formation. In this effay the author traces out the progrefs of the mufical gamut of melody and polyphonia, or finging in parts, in the different periods of the hiftory of mufic from their firft origin to their prefent refined ftate; and fhows, by hiftorical and äfthetic proofs, that all the arts, in regard to their formation, have had the fame progrefs; that is, from fimplicity to complexnefs, from rudenefs to refinement, from great to exalted, until the art, by corruption of tafte, again finks into trifling minutenefs, and becomes overloaded and fpoiled. From thefe obfervations the author deduces this practical refult for muficians, that unity and variety determine real beauty; that difcords, chromatic and enharmonic proportions, the alternation of quick and flow time, and a mixture of the exalted and lively ftyle, are ne-

ceffary

ceffary to enhance the value of confonant fimple proportions; and that variety in the unity, order, and fymmetry of the parts, alternation, and contrafts, and power combined with foftnefs, form the eternal laws of äfthetic beauty. The author at the fame time prefented feveral illuftrations, and a few curious unpublifhed fongs of the middle ages, with the old mode of notation in the form of cyphers, or the Hebrew accents, part of which he brought with him from Italy.

The prefident, C. F. Baron von Dacheröden, director of the Academy, prefented an urn, dug up a fhort time before near Strafsfurt, the height of which was fix and a half, and the width at the greateft diameter nine inches. The prefident obferved, as fomething remarkable, that this Germanic urn was found, with feveral others, in a low diftrict, though the burying-places of the ancient Germans were always on eminences. Near this urn were found feveral maffes of ftone, which feem to indicate a Druidical altar or habitation.

Profeffor H. A. Frank read fome obfervations which contained a criticifm on a fuppofed proof of hereditary difeafes. Some perfon having afferted in a late publication on hereditary difeafes, that the Roman families of Pifo, Cicero, Lentulus, Fabius, &c. acquired their names from certain fpots, marks, or moles, refembling different kinds of pulfe, which were peculiar to them, and which were tranfmitted through different generations, the author fhows that Plutarch and Pliny, who fpeak of the derivation of thefe names, partly do not make the above affertion, and partly are of another opinion. Thus, Pliny deduces the above names from this circumftance, that thofe to whom they were firft given diftinguifhed themfelves in a particular manner by the cultivation of pulfe.

Profeffor Jofeph Hamilton read a paper on the nature of the electric matter. He is of opinion that this matter confifts of light, fire, and the phofphoric acid.

Dr. G. Thilow prefented fome obfervations to confirm the difcovery of Ingenhouz, that oxygen has a great influence on vegetation. The author's experiments were the two following:—1ft, A weak, fickly dwarf-tree was befprinkled with a mixture of oil of vitriol and water. The tree-lice, which rendered

dered the plant ſickly, afterwards diſappeared, and the plant ſpeedily revived. 2d, A ſmall layer of an auricula (*Primula auricula* Linn.) by the ſame means, in the period of ſcarcely three weeks, was brought to a conſiderable ſize and full bloom. This plant the author preſented to the Society. The latter experiment, according to the author, would probably have ſucceeded in a ſhorter period had not the expanſion of the plant been retarded by two nights froſt.

In the ſitting of December 3, Profeſſor J. B. Trommſdorff read a paper entitled Collections towards a Chemical Knowledge of Mineral Bodies; which contained, 1ſt, A chemical analyſis of a black feld ſpar in the baſaltes of an extinguiſhed volcano of Unkel: 2d, The anatomy of a blue chalcedony from Siberia: 3d, The decompoſition of a dark black obſidian ſtone from Mount Heckla: 4th, The chemical examination of a heliotrope from Bohemia.

A paper was received from N. Müller, of Marktwipfeld, on the progreſs of diſtilling ſpirits from potatoes according to the author's principles; in which he endeavoured to ſhow that the country around Nieuwied had derived great benefit from this method of diſtillation, and from its becoming more general.

HEAT AND LIGHT.

By Dr. Herſchel's experiments on this ſubject, and which have been laid before the Royal Society, it appears, not only that the different coloured rays of the ſolar ſpectrum are endowed with very different powers of heating bodies; but that *heat* alſo comes from the ſun by *inviſible rays*, which are *leſs refrangible* than the red rays of the priſmatic ſpectrum.

ANTIQUITIES.

A peaſant of Steyermark, a few months ago, in digging at the large canal near Vienna, found an urn containing 298 pieces of the pureſt gold, of a ſtraw colour, ſomewhat ſmaller than Imperial ducats, but twice as thick, and conſequently equal in value to about an Engliſh guinea. Twenty of theſe pieces he immediately gave to one of his fellow-labourers, and with four others he purchaſed from a Vienna pedlar ſome clothes, with which, and the remainder of the

coins,

coins, he set out for Steyermark. Here, however, the circumstance was discovered by the magistrates, and 274 of the coins have since been transmitted to the Imperial cabinet. Twenty of these pieces are still wanting, but the Austrian government is making search after them. All these coins are in excellent preservation, but a few of them are a little cut. They comprehend 76 of Nero; 95 of Vespasian; 42 of Trajan, two of them exceedingly well preserved; 21 of Adrian; 10 of Antoninus; 12 of Domitian; 11 of Lucius Verus; 9 of Galba, three of them exceedingly good; 1 of Marcus Aurelius; 1 of Marciana; 8 of Faustina, three of them in fine preservation; 8 of Otho, and 1 of Æmilius.

The proprietors of an enclosure near Montpellier, in lately digging up a plantation, discovered a tomb in which was enclosed an alabaster urn, the cover of which was cemented down. On opening they found in it ashes, an alabaster incense-pot, the handle of which represented the head of a ram, a sepulchral lamp, and several pieces of money struck in the reign of Domitian. Another discovery for the amusement of antiquarians has also been made in France—a temple has lately been found which was dedicated to Ceres, and which, according to history, was situated on the road from Paris to Chartres.

A NEW EARTH.

Professor Trommsdorff has announced that he has discovered a new simple earth in the so called Saxon beryl. "I examined," says he, "this fossil, and expected to find in it glucine, but could discover no traces of it. The new earth which I found possesses the following properties, by which it distinguishes itself from other earths:—It is white, and totally insoluble in water. In a fresh state, when moistened with water, it is somewhat ductile. In the fire it becomes transparent and very hard, so as to scratch glass, but remains insipid and insoluble in water. The burnt earth dissolves very easily in acids, and produces with them peculiar salts, which are entirely void of taste. Fixed alkalies dissolve this earth neither in the dry nor the wet way; and it is equally insoluble with the carbonic acid and with caustic ammonia. It has a greater affinity to the oxalic than to other

other acids. I have given to this earth the name of *aguſt erde* (taſteleſs earth) becauſe a combination of it with acids is inſipid." Profeſſor Trommſdorff informs us, that a full analyſis of this earth, accompanied with an accurate deſcription of the foſſil by Dr. Bernhardi, as well as an analyſis of a German foſſil that contains chrome, will appear in the firſt part of the eighth volume of his Journal of Pharmacy, along with other eſſays of importance to chemiſts.

LEARNED TOUR.

A letter from Rome of a recent date contains the following article:—" Mr. Hamilton, a young man twenty-five years of age, nephew to Sir William Hamilton, the Britiſh ambaſſador at the court of Naples, and ſecretary to the Britiſh ambaſſador at Conſtantinople, is about to undertake a learned tour through Greece, Aſia Minor, Syria, and Egypt. With this view, during his reſidence in this city, he engaged various artiſts, to whom he is to allow handſome ſalaries. He takes with him as architect an Italian named Baieſtra; a ſtatuary, alſo an Italian, is engaged merely for the purpoſe of ſuperintending the caſts; as models of all the monuments not tranſportable are to be taken on the ſpot. Don Tito, of Naples, is to attend Mr. Hamilton, as landſcape-painter, and to deſign ruins; and the Calmuc Feodor, an ingenious draftſman and engraver, who about eight years ago was ſent by the court of Carlſruhe to Rome, but who was left there ſeveral years without any protection, and who on that account was in narrow circumſtances, is engaged to paint figures. Theſe artiſts are all engaged for two or three years. Mr. Hamilton proceeded from Naples to Palermo, and thence to Conſtantinople, where he paſſed the winter, that he might begin his tour through Greece in the ſpring.

" Beſides the above artiſts, Mr. Hamilton carried along with him from Naples a band of muſic. The whole travelling party, after they have been joined by ſome Engliſh gentlemen of fortune at Conſtantinople, will conſiſt of from ſixty to eighty perſons."

THE

PHILOSOPHICAL MAGAZINE.

MAY 1800.

I. *Description of the Island of Celebes or Macassar; with an Account of its Gold Mines, and the Manner of working them.* By *Mr.* VON WURMB *.

THE island of Celebes, called also Macassar, is of great importance to the Dutch † for the spice trade, on account of its situation, as it has on the north the Philippines, on the west the Sunda isles, on the east the Moluccas, and on the south Timor and Java. It extends from the third degree of north to the fifth of south latitude, and lies nearly under the 136th degree of longitude. It is about a hundred and twenty miles in length from north to south, and forty-five in breadth from east to west. Raynal says its diameter amounts to about a hundred and thirty miles, by which, in all probability, he understood its length from north to south. Properly the eastern side of the island is called Celebes, and the western Macassar; but in general the former name is given to the whole island, particularly by the Dutch.

As this island lies under the line, the air is exceedingly hot; but the heat is moderated by frequent rains and cooling breezes, and in most places the air is not prejudicial to the health of the inhabitants. It abounds with mountains,

* From *Merkwürdigkeiten aus Ostindien*, published by his brother.

† This island, since the author wrote, has fallen into the hands of the English.

tains, but the soil, taken in general, is fertile. Rice, cocoa-nut trees, mangoes, bananas, melons, and oranges, grow here exceedingly well, and are cultivated in abundance, together with the cotton shrub, *uby*, and *batta* *. There are here also plenty of horses, oxen, buffaloes, deer, wild swine, and birds of all kinds, and in particular a variety of beautiful parrots. Abundance of fish are caught on the sea-coasts as well as in the rivers and lakes.

The Dutch carry hither opium, spirits, lack, coarse and fine cloths, &c. and receive in exchange rice, wax, slaves, and gold. Here, as well as in many parts on the coast of Africa, the unfortunate beings doomed to slavery are not prisoners taken in war, or criminals, but people in general who have been kidnapped for the purpose of being sold; and it often happens that relations do not hesitate, for the sake of gain, to deprive their fellow-creatures of liberty, the greatest blessing which mankind enjoy in the present life. The island is well peopled: on the coast of Celebes alone there are said to be fifty-six thousand inhabitants, seventeen thousand of whom are capable of bearing arms.

In this island there is a multitude of small kingdoms and states, the greater part of which, however, depend on the two great kingdoms of Macassar and Bony. The king of Ternate, also, has extensive possessions, which occupy almost the whole of the northern and eastern part of Celebes. The two most powerful kings, whom the Dutch, by the preponderance of their arms, obtained as allies, are the kings of Macassar and Bony. The kings of Tello and Sandrabony are in alliance with the king of Macassar; and those of Soping, Luhu, and Tanette, with that of Bony. Some small states, such as Wadjo, Mandhaar, &c. are independent. Though the kings of Macassar and Bony are allies of the Dutch, they are always sworn enemies to each other; and this is not unfavourable to the policy of the Dutch, who in their Indian possessions still keep in view the maxim *divide et impera*, and

* *Uby* is a root used as food, and *batta* is a kind of buck-wheat, which formerly was the chief food of the Javanese before they were acquainted with the use of rice.

who

who derive great advantage from the difcord of the eaftern princes.

The kingdom of Macaffar or Goach lies on the weftern fide of the ifland, of which it occupies the greater part. The king of Goach and that of Tello both bear the title of Macaffar, though each has a diftinct kingdom: they affume the titles of Goach and Tello from their places of refidence. According to an ancient tradition, the Macaffars, like many other nations, deduce the origin of their princes immediately from the gods. Once, fay they, after the death of the firft fovereign of the kingdom, a beautiful female defcended from heaven fufpended by a golden chain. This celeftial beauty, named Tumanurong-a, was immediately chofen by the Macaffars to be their queen. She afterwards married a king of Bonthain, and, after being pregnant three years, brought forth a wonderful child, capable of fpeaking and walking as foon as it was born, but exceedingly ugly and deformed. This young prince was named Tuma-Salingabeerang. When he attained to manhood he broke the golden chain which his mother had brought with her from heaven, and the mother and her hufband inftantly difappeared, and left to their fon the kingdom, together with one half of the chain. This chain, which, it is afferted, was fometimes light and fometimes heavy, and fometimes appeared of a pale colour, was long preferved as a valuable part of the regalia of the crown, until it was loft, with various other rarities, during the warlike commotions which took place in this kingdom about the middle of the prefent century. This Tuma-Salingabeerang is confidered as the chief of the family of all the kings of Goach.

The Dutch were involved in violent difputes with thefe fovereigns before they were able to eftablifh themfelves in their kingdom. In the year 1778 Goach, the capital, was taken by ftorm and deftroyed; and in 1781 the prefent king Punduca Siri, fultan Abdal Hadja, was placed on the throne by the government of Batavia. The king of Goach does not enjoy unlimited power, but is fubject to certain laws, which he is obliged ftrictly to obferve. He can undertake no meafure of importance without the confent of his council, nor

can he inflict arbitrary punishment on criminals, who must be punished according to the laws. He has a privy council called *Tonulalangs,* and every village is under the direction of a particular governor distinguished by the title of *Galarang.*

The Portuguese visited this island about the beginning of the sixteenth century, and obtained from the sovereign then on the throne permission to form an establishment. The successors of this prince introduced the weights and measures now in use, fixed the prices of merchandise, manufactured gunpowder, and planted the first cannon on the walls of Goach. He gave permission also to the Malays not only to reside in his kingdom, but to erect a Mahometan temple. This religion made such progress here, that about the year 1588 deputies were sent to Mecca to bring from thence a hadja or priest to instruct the Macassars in the doctrine of Mahometanism, which in 1603 was established throughout the whole kingdom under the sultan Allahudier.

The kingdom of Bony, which lies on the western side of a bay, called on that account the Bay of Bony, is the second kingdom in point of importance in the island. It is in close alliance with the two small kingdoms of Soping and Luhu. The natives of Bony, that they may not appear inferior to the Macassars, deduce their origin in the like manner from the gods. The first king, they say, descended from heaven, and was known by the name of Matta-Solompo-e, that is, the all-seeing. This sovereign, after reigning forty years, resigned the kingdom to his son, and with his wife ascended again to heaven: but, notwithstanding this common descent of their rulers from the race of the gods, the Macassars and people of Bony are sworn enemies, and their incessant quarrels greatly contributed to enable the Dutch, who, according as their interest required, favoured sometimes the one party and sometimes the other, to make themselves masters of the island. At present the Bouginese, or people of Bony, are the most powerful, as the Macassars were about a century ago.

The Bouginese are of a middle stature, and have a brown complexion, but not dark. Among the female sex, in particular, some are found almost entirely fair. Their features in general are agreeable, only that the nose is a little flatted.

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The Macaſſars, on the other hand, are of large ſtature, have a manly warlike appearance, are of a more open diſpoſition, and at the ſame time deteſt treachery; while their opponents, the Bouginеſe, never attack openly, but endeavour to fall upon their enemies by ſurpriſe. Thoſe even who never did them an injury are not ſecure from being murdered by them when they can do it with privacy; and they often commit ſuch actions for no other reaſon, as they ſay, than to try the goodneſs of their daggers. Many Macaſſars, as well as Europeans, have fallen a ſacrifice to this thirſt for blood. Their daggers and aſſagays are for the moſt part poiſoned, as well as their ſmall darts, which they can ſhoot at their enemies to a conſiderable diſtance by blowing them through a tube.

Their clothing conſiſts of a piece of red or blue cotton cloth wrapped round the body, and drawn through between the legs. The upper part of the body is quite naked. On the head they wear a piece of cotton cloth in the form of a handkerchief, with which they cover their hair, which is as black as pitch, and exceedingly long. On the other parts of the body neither the men nor the women ſuffer any hair to grow; they pull it out by the roots, in the ſame manner as the Mahometans and Indians, as ſoon as it appears. They feed for the moſt part on rice, fiſh, and piſangs; and their beverage is water, though they are not deſtitute of *ſagueer*, or palm wine. The Bouginеſe women are in general much handſomer than thoſe of the other Indian tribes: ſome of them, had their complexion the ſame mixture of red and white as our females, would be accounted beauties in Europe. They are naturally of an amorous diſpoſition, and are capable of undertaking any thing to gratify their inclinations.

The Mahometan religion, which has here become general, permits the Bouginеſe to have four lawful wives, provided the huſband can maintain them. If the parties, however, are not ſatisfied with each other, they may ſeparate with as little trouble as they were united. Their funerals are attended with very little ceremony. The body is wrapped up in a piece of white cotton cloth and depoſited in the grave, over which ſome ſweet-ſcented flowers are ſtrewed, and two ſtones are erected, one at the head and another at the feet. The

Bouginеſe

Bouginefe have a fort of game at cards, which in all probability they learned from the Portuguefe. It has a great fimilarity to that called *tarocco*, though the twenty-two tarocs are not among their cards. The four colours are called *fpada*, *datudyens cafo ftokke*, *copas-coufel*, and *boelang-rofy*.

As the Dutch readily faw the great importance of this ifland, particularly in regard to their fpice trade, they did every thing in their power to form a fettlement in it, and even at an annual expenfe, which confiderably exceeded the income arifing from their trade: the abbé Raynal makes it to be 165,000 livres. The caftle of Rotterdam, which is the principal refidence of their Eaft India company in the kingdom of Macaffar, lies in the latitude of 5° 7′ fouth, and the longitude of 136° 50′. It was conftructed by the Portuguefe with the affiftance of the Macaffars, and was afterwards beautified by the Dutch, who increafed its fortifications. Some years ago a neat church was erected here capable of containing two hundred perfons. The walls of the fortrefs, which are ftrong, and of confiderable height, are built entirely of ftone hewn from the rock. On coming out by the land-gate you arrive at a large plain, on the north fide of which lies the village of Blaardingen, where the principal part of the Europeans refide. The ftreets, which are broad, and ornamented with beautiful buildings, interfect each other at right angles in the direction of the four points of the compafs. At the end of one of them is a large edifice fet apart for an orphan-houfe. The Chinefe all live together in one ftreet, called for that reafon the Chinefe ftreet. Blaardingen is furrounded with palifades, and is furnifhed with gates, which are fhut in the night-time. Without the palifades, towards the fouth, there is a row of buildings, one of which is the habitation of the governor, and at a little diftance there are fome places called *campongs* inhabited by natives and Europeans.

The road of Macaffar is one of the moft beautiful in India, and at the fame time fafe for fhips at every feafon of the year. The diftrict around it is exceedingly pleafant. It confifts of a large plain feveral miles in extent, in which, as far as the eye can reach, nothing is to be feen but rice-

fields and meadows watered by ſmall ſtreams. The picturesque appearance of this ſcene is heightened by groves and ſcattered clumps of ſhady trees loaded with fruit. Towards the eaſt it is bounded by lofty mountains, called the mountains of Bonthain, which divide this part of Celebes towards the weſt from Bony, and towards the ſouth from the gulph of Tomini into two parts.

The ſeaſons are here the ſame as in Java. The ſouth-eaſt monſoon continues from May till November, and is called the favourable monſoon: the north-weſt, called the bad monſoon, continues from November till May. During the former the ſky is ſerene and the weather dry; but continual winds and violent rain prevail during the latter. It is very ſingular, that on the eaſt ſide of the before-mentioned mountains of Bonthain the contrary takes place: for, when fine weather in the ſouth-eaſt monſoon prevails on the weſt ſide of the mountains, there is nothing but hurricanes and rain on the eaſt ſide; ſo that the boundaries of ſummer and winter are only a few miles diſtant from each other. The principal productions here are rice and cotton. The rice, however, is inferior in quality to that of Java, but the cotton is the beſt in India.

The Dutch Eaſt India company poſſeſs the caſtle of Rotterdam, called in the language of the country Adjong Pandang, together with the ſurrounding diſtrict, in conſequence of a treaty which they entered into with the prince of Celebes. But as the boundaries of their poſſeſſions were perhaps not accurately defined, the company always endeavoured to enlarge, and the Macaſſars on the other hand to confine them. The company poſſeſs alſo a peninſula extending from this place towards the north, and a large flat diſtrict, which, on account of its fertility, is conſidered as the granary of Celebes, together with ſeveral places lying between this plain and the mountains, and likewiſe a great many villages among the mountains. Theſe places border on each other, and are bounded on the weſt by the ſea, on the north by the kingdoms of Tanette and Maros, on the eaſt by Tamari, and on the ſouth by the kingdom of Macaſſar. The inhabitants

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of them, after various revolts, were at laft reduced to complete obedience in 1738.

I fhall omit faying any thing of the other fmall kingdoms in the ifland of Celebes, and proceed to a defcription of its gold mines, and the method in which the gold is collected. Mining and the art of metallurgy are conducted in a very carelefs manner in India; which is owing partly to the ignorance of the natives, and partly to their indolence. In general it needs excite little furprife, that people who live in a mild climate, and who have few wants, fhould be little inclined to penetrate into the bowels of the earth to procure metals, which are immediately extorted from them by the avaricious Europeans, or of which they are in a great meafure deprived by their own princes. If an Indian here and there be compelled by force or neceffity to dig for or collect gold, he never goes to work with fufficient intelligence and activity, but contents himfelf with what he can procure to fatisfy his wants in the eafieft and fpeedieft manner. This is exactly the cafe with the Indians who inhabit thofe parts of Celebes which produce gold.

They obtain that metal by collecting the fmall particles which have been carried down by the ftreams, or by wafhing the fand which they dig up, rather than by working the mines in a regular manner. The auriferous mines in the ifland of Celebes commence on the fouthern fide of Bulang and the northern fide of Kotta-Buna or Mogondo, and proceed thence to Dondo on the fouth-weft, and Tamperana on the north-weft fide, at the Bay of Tomini. Every where between thefe two diftricts gold is found in a greater or lefs quantity. Where the land of Celebes becomes fo narrow, and the mountains fo low, that a perfon can with eafe pafs from the one coaft to the other in a few hours, the auriferous mountains end; and on the whole coaft on the other fide, as far as Macaffar, a fingle gold mine is not to be found.

Befides the mines already difcovered, a great many others would no doubt be found, were there a fufficiency of labourers; for the villages in thefe auriferous mountains are exceedingly ill peopled. Another caufe of thefe treafures being

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ſo much neglected is the ignorant ſuperſtition of the natives. They never will venture to dig in any place where they ſuſpect great riches to be concealed until they have ſent thither a diviner, as he is called, to find out whether their labours will be attended with ſucceſs. The whole art of theſe diviners, called in the language of the country *Talanga*, conſiſts in their diſcovering, as they pretend, by the voice of a certain bird, whether abundance of gold is to be found in a certain place; whether the labourers will be attacked by ſickneſs; whether there are in it many ſpirits to impede the labourers and conceal the gold from them, with other things of the like kind. If the bird gives a favourable anſwer to all theſe queſtions, the diviner muſt endeavour to ſecure the favour of the protecting ſpirits of the place by offerings of various kinds; after which a few workmen may begin digging, and continue their labour as many days or months as the bird has preſcribed. If the bird, however, gives an unfavourable anſwer to only one queſtion, no perſon will venture in ſuch a place to dig a hole of only a few inches in depth. Many rich mines remain, therefore, unexplored, becauſe the prophetic bird, or the *Talanga*, are not in good humour.

When the workmen have arrived at the place where, according to the permiſſion of the *Talanga*, they may dig up gold, they hold ſerious counſel with the bird once more, and aſk it in what particular ſpot they muſt begin. When this is done, they firſt conduct water to the ſpot; for without water they cannot proceed, as by its means they waſh away the earth and clay from the pit, that the ſtones and fine ſand, among which the gold is contained, may remain pure. If the ſituation of the ground will not admit of the water being conducted in furrows, they make a kind of gutters of hollow *wakka* trees, which they ſupport with props. When they have brought the water to the place where the mine is to be worked, they make a pit of twenty, thirty, or forty feet in circumference, according to the number of workmen: ſometimes there are eight, and ſometimes ten or twelve. As long as the water has room to run off, they ſuffer it to carry with it the earth, which they keep continually turning and ſtirring in the pit; but when the pit becomes ſo deep that there is

no paſſage for the water, they muſt bale it out till they arrive at the ſtones. Theſe they waſh clean, and build them up regularly around the ſides of the pit, but without lime or mortar, to prevent the earth from falling in. When the pit is carried to a very great depth, they ſecure theſe ſtones by means of boards and beams of wood. Theſe poor miners find ſometimes ſtones of from three to four and five hundred weight, which they are obliged to raiſe and remove from the pit without any other machines than a common wooden lever.

When all the earth, clay, dirt, and ſtones have been thrown from the pit, and a kind of black ſand begins to appear, they are then ſure that they ſhall find gold. This ſand they take up in a kind of ſmall ſhovels made for the purpoſe; and, having placed themſelves in the water, they put one handful of the ſand after another on ſmall round wooden diſhes named *dulangs*. Theſe *dulangs* are about eighteen inches in diameter and ſomewhat hollow, and have a ſmall cavity in the middle which can be cloſed with a wooden cover. When all the ſand has been waſhed from the *dulang* by being continually ſtirred round with the hand, the gold, which is much heavier, remains in the abovementioned cavity. When it can receive no more, they take the gold which has been collected, and hold it over the fire in a coco-nut ſhell till it is dry; after which they blow away the remaining ſand as well as they can, and preſerve the pure gold.

When they dig a hill or mountain which is ſituated cloſe to a river, they employ another method to obtain the gold. In this caſe they make a pit at the edge of the river, conduct into it as much water as they have occaſion for, throw into it the earth they have dug up, and waſh it till nothing remains but the black ſand mixed with gold; after which they waſh it in their *dulangs*, as already deſcribed. This is the eaſieſt method of procuring gold, provided it can be employed. They have, however, a third method; but it can be uſed only in mines newly diſcovered. They go into the river with a baſket on their back, and a piece of iron reſembling a thick chiſel, which has a wooden handle, and ſearch the fiſſures and crevices of the rocks, where they ſometimes find lumps

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of gold equal in weight to two or three rials. In other refpects, the art of digging for gold is the fame in all the mines and among all the people on this coaft. The only difference is in regard to the depth of the pits. In many places it is fcarcely neceffary to go deeper than ten or twelve feet; but in others the pits muft be carried to the depth of feveral fathoms, and the fides muft be fupported by means of boards and beams. The inftruments ufed in thefe mines confift only of a piece of iron about a foot and a half long and two inches in thicknefs: it is pointed and fharp at the one extremity, and at the other is furnifhed with a focket, into which is ftuck a wooden pole about fix feet in length. Thofe who are able to procure it have alfo an iron hook, with a fhort wooden handle, which they employ for loofening and turning up the earth around ftones. A mattock, with the abovementioned *dulangs*, which each miner makes for himfelf, and a pair of gold fcales, form all the reft of their apparatus.

When a gold mine is difcovered, the workmen do not immediately begin to dig it, but firft fearch the neareft river, in which they turn up the ftones and drain off a part of the water. After they have turned up the fand to about the depth of a foot, they fometimes find large pieces of gold, which in all probability have been wafhed down by the ftreams from the mountains. It has been remarked that the rocks on the borders of rivers, and even the greater part of the ftones which are taken up from pits where the ore is rich, have a blue, and fometimes yellow, colour, and are fo foft that they may be ufed as paint. Where the gold is lefs rich, the ftones are gray or white, and either of a hard texture, or foft like limeftone. By thefe figns the produce in gold of any mine may be eafily afcertained.

In all the gold mines, but particularly thofe which lie at a diftance from the fhore, it is exceedingly cold before funrife and after fun-fet. On this account the poor miners fuffer a great deal. As they are obliged to fit in the water from morning till night, their bodies, when they ceafe from their labour, are almoft rendered quite white by the faltpetre. When the mines are worked, the water of the river near which they are fituated is muddy, and of a reddifh-yellow

colour down to its mouth; and those who are so imprudent as to drink of it are seized with a dangerous dysentery.

The labour of the miners is not always attended with the same success; for it sometimes happens that they work a month and longer, during which they spend several dollars, without finding gold of the value of one. In that case they are obliged to dig in some other place, and to renew their labour. In newly discovered mines they are for the most part successful; but in mines that have been worked for some time, they are often obliged to labour a whole month before they obtain any gold. The quantity and value of the gold which is found in any mine cannot be accurately ascertained. One workman, also, is often more fortunate than another. In newly discovered mines there are labourers who sometimes, in the course of fourteen days, find to the value of two hundred dollars; whereas in other places the value of twenty dollars is scarcely found in the course of a year.

In the wide extended gold mines of the river Palella, which divides itself into several branches, there are places where gold is exceedingly abundant; but in such places it is of less value, being scarcely eighteen carats fine. The best gold comes from the mines of Popajatu, Molisipat, Ankahulu, Tolodinki, Lembuno, Sonsso and Tamperana; also from the south and south-west side of Pogiama, Wongo, Tomollas Bevool, and Tontoly. The gold procured from all these mines is for the most part above twenty carats fine. Frederick Dühr, a servant of the Dutch East India company, who visited these mines a few years ago, is the only person who has given an authentic account of them. Those who travelled through these districts before him, never saw the gold mines, but only visited the habitations of the chief civil officers, which are at a considerable distance from the places where the gold is dug up; and the chief men among the natives are too indolent to undertake journeys along those difficult and dangerous roads which conduct to the mines, and in which people are often in danger of breaking their necks.

Within the extent of the gold mines of Ankahulu there is a place called Longi, which produces a kind of gold that in fineness

fineneſs exceeds even that of Popajatu and Ankahulu. This place, however, is little frequented, becauſe the ſmall river near which it is ſituated is not navigable, and the inhabitants are obliged to carry their proviſions on their backs along a difficult and dangerous road. Beſides, the miners often find in this place a great deal of copper, which, when they have no acid to put it to the teſt, often deceives them, as they at firſt take it to be gold. This is the only mine on the north or north-weſt ſide where copper is found. Near Bevool, on the ſouth or ſouth-weſt ſide, there is another where good copper is dug up in duſt, which is as fine as the fineſt gold-duſt. In the mines of Bombula, Batodulang, Ankahulu, and Palella, a great deal of rock-cryſtal is found, and likewiſe a kind of iron ore.

In almoſt all the mines which the before-mentioned Mr. Dühr viſited, he obſerved, that the workmen, when they had dug to the depth of five, and in ſome places of twelve feet, came to a horizontal ſtratum of rock, which with their inſtruments they were not able to penetrate. They, however, frequently told him, that they firmly believed that they ſhould find gold below theſe rocks, if they could break through them. He ſaw alſo at Ankahulu, where a ſtratum of ſuch rock is found, at the depth of from twelve to fifteen feet, that there were fiſſures in it, two or three inches wide, which contained a blackiſh ſubſtance almoſt like ruſt of iron, mixed with a great many pieces of gold, and which the workmen, after they waſhed the rock perfectly clean, dug out to as great a depth as they could with their tools. In all the mines of Celebes, the gold, when ſeparated from the ſand, is of conſiderable fineneſs. At Pogiama and Palella alone gold ore is found here and there, mixed among other ſtones; but it is not rich, and the gold muſt be extracted by pounding the ſtone, which is not very hard.

II. *Ob-*

II. *Obſervations on preſerving Specimens of Plants.* By JOHN STACKHOUSE, *Eſq. F.L.S.* *

IN proſecuting my reſearches with a view to complete the hiſtory of the Britiſh *Fuci*, I was deſirous to diſcover, if poſſible, a method of preventing the olive-coloured, coriaceous ſpecies from turning black in drying. For this purpoſe I tried the experiment of immerſing them in a ſtrong ſolution of alum. The reſult of my experiment did not anſwer my expectation. They were prevented, indeed, from turning black, but they acquired a greeniſh hue. However, imagining this might ariſe from the mixture of aluminous with muriatic ſalts, and being of opinion that the properties of alum might be of great uſe in preſerving land plants on ſeveral accounts, I ſet on foot a courſe of experiments, and am happy to ſay, that the reſult has been favourable to my expectations. After repeated trials, during which partial failures occurred, owing to the proportioning the degrees of ſtrength of the ſolution, and the admiſſion of light and air during the time of drying, I can ſafely recommend to the public attention the proceſs which follows, not doubting but that many improvements will ſuggeſt themſelves to thoſe who poſſeſs a chemical knowledge of the various ſubſtances made uſe of by dyers in fixing their colours.

Take a ſaturated ſolution of powdered alum in common water: immerſe carefully your ſpecimen, flowers, leaves and ſtalk in this liquor. During this immerſion, with a camel's-hair bruſh, ſuch as varniſhers make uſe of, wet thoroughly a ſheet of blotting-paper: diſplay your ſpecimen carefully on this paper, and prepare another ſheet in a ſimilar manner to lay over your plant. Then give a ſmart preſſure to your plant, either with a botanical preſs, a napkin preſs, or weights of any kind applied to the ſpecimen placed between ſmooth boards, or books, obſerving to lay about half a quire of paper below the ſpecimen, and the ſame quantity above, to take up the moiſture. After a day or two, according to the

* From the *Tranſactions of the Linnæan Society*, Vol. V.

the ſucculency of the plant, and when the aluminated paper appears perfectly dry, your ſpecimen may be removed into freſh paper, and kept carefully under gentle preſſure, with the edges of the paper folded over each other to prevent every poſſible admiſſion of light and air till its removal into the herbarium. For thoſe who wiſh to affix their ſpecimens, (and it is ſcarcely poſſible to effect the preſervation of the delicate tints of the petals of many kinds without a ſtrong adheſion to, and almoſt incorporation with, the paper,) the time above mentioned, that is, when the aluminated paper is thoroughly dry, is the proper time for proceeding with the operation. Have ready a paſte made with flour and water, with alum mixed in it, ſuch as upholſterers uſe, ſtrong gum-water, or iſinglaſs-glue: apply either of theſe to the back of your ſpecimen with a bruſh; then fix it carefully on ſtrong writing or drawing-paper, by laying your paper ſmoothly on the ſpecimen as it lies, preſſing it gently with your hands and a cloth, and then turning over both together. When this is done, iron the plant with a box-heater in the manner recommended by Major Velley in Dr. Withering's *Arrangement of Britiſh Plants, v.* 1. *p.* 34, if you have the conveniences; if not, apply an immediate and ſmart preſſure, as before directed.

It is taken for granted that thoſe who wiſh to profit by theſe inſtructions, are practiſed in the uſual methods of preſerving dry ſpecimens, and that they are aware that particular care ſhould be taken to pare off the back parts of thick woody ſtalks, and of the globoſe, ſucculent heads of flowers, as well as of the buds of thoſe intended to be paſted down, previous to their preſſure. For the moſt ſatisfactory information on theſe particulars, the reader is referred to the Introduction to Dr. Withering's excellent work above mentioned. It is almoſt needleſs to mention, that aluminated ſpecimens will be completely guarded from the eroſion of inſects, as well as from the danger of being injured by damps; and therefore the proceſs will be particularly valuable to thoſe who viſit foreign countries.

As beauty and durability are of ſo much conſequence in the arrangement of an herbarium, and as plants cannot be preſerved

preserved any length of time in perfection even with the usual apparatus of a *vasculum*, or tin-case, no botanical traveller should be without a small press, such as that described in Dr. Withering's *Arrangement*, *v.* 1. *p.* 31. It may be framed so as to admit of a drawer for receiving the preserved specimens; either thin enough to lie under the feet in a post-chaise; or, as a seat for a third person is often desirable, it may be contrived to be as high as the seat of the carriage, with a corresponding cushion on the top.

III. *A cursory View of some of the late Discoveries in Science.*

[Continued from Page 251.]

ANATOMY OF ANIMALS.

CUVIER has made many researches respecting the organisation of insects, and the manner in which nutrition takes place among them. "I think I am the first," says he, "who has distinguished worms into two grand families; the moluscæ, which have a heart, and a complete system of circulation; and zoophytes, which have neither. I have described the heart, and the vascular system of the principal genera of the moluscæ; and I have proved that their venous vessels perform at the same time the function of absorbing vessels." He then shows that insects have neither a heart nor vessels of circulation. Malpighi observed in the silk-worm a large knotty vessel extending along the whole back, and he believed that this vessel performed the functions of the heart and aorta, and that the same organisation existed in all insects. This opinion was adopted by all naturalists. Cuvier has carefully examined this vessel, as well as the whole organisation of insects; but he observed no movement of fluids, or circulation. Almost the whole body of the insect is filled with tracheæ; from which he concludes that there is no real circulation in these animals, and that their nutrition is performed by immediate absorption, as is evident in polypes and other zoophytes, which are found immediately below insects in the scale of organic perfection.

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He then examines the organifation of the medufa or fea-nettle, and fhows that it approaches near to that of vegetables. "If I confined myfelf," fays he, "to announçing, that there exifts an animal without a mouth, which is nourifhed, like plants, by means of ramified fuckers, and in which the ftomach fupplies the place of heart, one might have fome right to refufe affent to fo extraordinary an affertion; but I exhibit the animal itfelf." He then explains the nature of its organifation. This animal has no mouth, but only fome *oftioles*, or very fmall apertures, which all terminate at a large cavity or bag, which may be confidered as the ftomach. From this cavity proceed fixteen veffels, which are diftributed to every part of the animal, and have a communication with each other by means of a circular veffel exactly concentric to the contour of the animal. Thefe veffels ferve to convey the nutritive juice. No heart is obferved in this animal, nor any organ analogous to one.

Cuvier has compared alfo the brain of various red-blooded animals. The character of that of man and apes is, the exiftence of the pofterior lobe and the digital cavity. The character of the brain of carnivorous animals is, the fmallnefs of the *nates* in regard to the *teftes*. In herbivorous animals the *teftes* are much larger than the *nates*. That of the brain of *rongeurs* (the ftag kind) is the fize of the *nates*, and the abfence or fhallownefs of the circumvolutions. That of the brain of the folidipedæ is the fize of the *nates*, joined to numerous and deep circumvolutions. That of the brain of cetaceous animals is its great breadth in proportion to its length, and the total abfence of olfactory nerves. Man and quadrupeds alone have olfactory nerves properly fo called: in real quadrupeds they are fupplied by mammillary caruncles.

Sue has defcribed the manner in which he prepares the fkeletons of animals. He firft boils them in water, as was practifed by Daubenton; after which he pours water over them, or throws it upon them with force from a fyringe. By thefe means all the flefh detaches itfelf from the bones, which remain perfectly clean.

Dumeril has obferved, that the laft articulation of the fingers in mammiferous animals always retains a peculiar

character in each species. He proposes to give to this articulation the name of the *os unguinalis*.

ANIMAL PHYSIOLOGY.

Léveillé has given a very curious work on the manner in which young oviparous animals are nourished in the egg. He compares it with that in which nutrition is performed in the fœtus of mammalia, and shows:

1. That the fœtus of mammalia is nourished only by the umbilical cord, and that it receives no nourishment by the mouth: that the same thing takes place in the young oviparous animal enclosed in the egg; and to prove it, he gives the anatomy of the egg, and of the membranes which envelop the fœtus.

2. That the egg, when incubated, consists of the eye (*cicatricula*), the yolk, three distinct albumens, an absorbing canal, five membranes, sanguine and serous vessels.

3. That the third albumen is divided into two parts, united by a very thin prolongation: that their position is not at the two opposite poles of the yolk, and that each has for its centre an annular cordon; in one of them it is membranaceous, in the other vascular.

4. That there exists a communication between the albuminous mass and the capsule of the yolk, by means of this absorbing conduit.

5. That the yolk has no suspending ligament, and that it floats at freedom in the interior of the white.

6. That the volume of the albuminous mass decreases in proportion to the time of incubation, while that of the yolk increases; which seems to prove that the one absorbs the other.

7. That the first albumen having no communication with the other two, there is reason to presume that it is absorbed by the vessels of the sacciform membrane. It is this which is cemented to the shell of the egg, except at the broad end.

8. That the yolk, besides its augmentation of bulk, has very great fluidity; and that it is absorbed by the vascular membrane, which forms its proper tunic.

9. That it is proved by experience that there are no yellow vessels

veſſels nor valvulæ in the interior of the *chlorilime* membrane; that is to ſay, that which encloſes the yolk of the egg.

10. That the chicken, conſidered as fœtus, is enveloped in a peculiar membrane, that ſeparates it from the yolk, with which it has a connection, and from the white, with which it has none, and from which it is at a conſiderable diſtance.

11. That all ſubſtances deſtined for the nouriſhment of this fœtus are contained in diſtinct capſulæ ſeparated from it.

12. That there exiſts a perfect analogy between the veſſels of the yolk and thoſe of the placenta; and that the former are to the yolk what the ſecond are to the matrix, except the difference in the circulation.

13. That, contrary to the opinion of Haller, the albumen does not communicate with the aqueous bag; and that the chicken makes no uſe of this fluid for its nouriſhment.

14. During the latter period of incubation, every thing left enters into the abdomen of the chicken in ſuch a manner that no umbilical cord remains without.

15. That the red-blooded animals, which live in air, may be divided into two grand claſſes, the umbilical and non-umbilical.

Dr. Jenner has made an intereſting diſcovery in regard to the cow-pock. He obſerved that cows were ſubject to puſtules on their teats. Thoſe who milk them acquire puſtules alſo; and it is very extraordinary that by theſe means they are preſerved from the ſmall-pox. He inoculated with the cow-pock in the ſame manner as with the common ſmall-pox, and by theſe means produced the ſame effects as when people acquire the diſeaſe by touching the puſtules of cows; that is to ſay, theſe people are not liable to the common ſmall-pox, either by communication or inoculation. Theſe facts have been confirmed by ſeveral other phyſicians, ſuch as Drs. Pearſon, Pulteney, &c. Dr. Woodville, phyſician to the Small-Pox Hoſpital, has inoculated in this manner ſeveral hundred perſons. This diſcovery is of the utmoſt importance to humanity; for it is well known that the natural ſmall-pox is one of the moſt deſtructive of all thoſe diſeaſes

which afflict mankind. Inoculation, therefore, ought no longer to be performed with the matter of the common small-pox or variolous matter, but with the vaccine; because inoculation with the latter is free from all danger, whereas that with matter of the common small-pox is attended sometimes with fatal consequences.

Herholdt has proved that the liquor of the amnios penetrates sometimes into the tympanum of the fœtus; from which he concludes, that it introduces itself sometimes, also, into the tracheal artery, and fills it before birth. When the child is brought forth, it is necessary, therefore, to assist that liquor in flowing off. Nature generally operates in this case alone; but its efforts are sometimes ineffectual, and the child is supposed to be still-born. In such circumstances it must be assisted. This the author did in thirteen children, whom he restored to life by facilitating the escape of the liquor.

Dr. Buvina has made experiments which tend to prove, that in living animals the red blood is retained in its proper cavities by the active vitality of the parts, rather than by the smallness of the vessels and pores. This he proved by making injections of blood. These injections in the living animal penetrate only to the vessels, in which it circulates during life. This he proved in a living calf; but, having deprived the animal of life by cutting the spinal marrow, the injections immediately penetrated to the most delicate vessels of the periosteum and other parts, and gave them a red colour, which they have not in the living animal. He has even seen the blood issue from wounds, such as those of vesicatories. He thence concludes, that if the blood in the living animal does not penetrate to several delicate vessels, such as the lymphatic, it is on account of the resistance opposed to it by the force of vitality, and not on account of the smallness of the orifice of the vessels. The spontaneous echymoses, which take place in the scurvy and some other diseases, seem to arise from the weakness of the vital forces, which permit the blood to penetrate to the capillary vessels.

The same author has demonstrated, by direct experiments, that a portion of the bone of a body, newly deprived of life,

may

may be engrafted on the bone of a living animal of the ſame or of a different ſpecies.

In conjunction with Vaſalli, he has made experiments to aſcertain whether the opinion of the ancients, who pretended that contagious diſeaſes are produced by inſects, be true; but their reſearches have ſhown them that this opinion has no foundation.

Pinel has publiſhed numerous obſervations, which he has had occaſion to make, on idiots and maniacs. He ſhows that kind and gentle treatment, but attended with firmneſs, often calms the fury of thoſe unfortunate perſons, and is frequently ſufficient to reſtore them to reaſon.

PHYSIOLOGY OF VEGETABLES.

Desfontaines has given a memoir on the cultivation and uſes of the date-tree, ſo valuable to the inhabitants of hot countries. Theſe palms, as is well known, are of the family of the *diœcia*, the male flowers of which are borne on one ſtalk and the female flowers on another. The male flowers, deſtined for fecundation, are detached from the trees about the end of March, before the antheræ have ſhed their farina. They are prepared in ſuch a manner that they can be tied to the females: they are hung up and dried in the ſhade; and in this manner they will retain their virtue till the year following. Towards the end of April they are attached to the female date-trees, which are thus fecundated; becauſe it would be very imprudent for men, whoſe whole nouriſhment is confined to the fruit of this palm, and who inhabit the boſom of the deſerts, to truſt for the fertility of theſe trees to the winds, which, in ſome caſes, may convey the fecundating farina.

Linnæus made known a part of the wonderful phenomena exhibited by the *valiſneria* at the time of its fecundation. Picot la Peyrouſe has added ſome new details. This plant belongs to the *diœcia*. The male and female always grow at the bottom of the water. At the moment when the male is about to flower, its ſtalks, which are terminated by a flat ſheath, burſt, and the flowers are thrown out on the ſurface of the water; where they unite, and float about at the pleaſure

ſure of the winds. The females, which have a very long ſtalk, turned into a ſpiral like a ſpiral ſpring, riſe at the ſame time to the ſurface of the water by the expanſion of their ſtalk; agitate themſelves around the male flowers, which approach them; and when the rays of the ſun begin to heat the horizon, the ſtalk falls back, and carries with it, below the water, the female flowers, which then ſhut. But in the evening, as ſoon as the ſun ſinks below the horizon, they reappear on the ſurface of the water. This is repeated ſeveral times, but the author has not determined the number. In the laſt place, when the fecundation is effected, the ſtalk falls back entirely, and carries with it, to the bottom of the water, the flower and the germ.

Coulomb having cauſed to be cut down, towards the end of April, ſome Italian poplars covered with flowers, obſerved that one of them, which had been cut at the diſtance of ſome lines from the axis of the tree, emitted at the cut a noiſe like that produced by the air when it iſſues in abundance, and in ſmall bubbles, from the ſurface of a fluid, and that a great deal of ſap flowed from it. This experiment, being repeated ſeveral times, was always attended with the ſame ſucceſs; from which he concludes, that the ſap in large trees does not aſcend in a ſenſible manner, but towards the axis, which forms the medullary canal. To aſcertain this fact, he cauſed ſeveral of theſe trees to be pierced with a gimblet; but the inſtrument was ſcarcely moiſtened till it had arrived within two or three centimetres of the centre of the tree: when it approached the centre, ſap iſſued in abundance, with a continued noiſe of air-bubbles, which aſcended with the ſap, and burſt in the orifice formed by the gimblet.

Sauſſure the ſon has publiſhed reſearches on the influence which oxygen gas has on the germination of plants. The greater part of naturaliſts, ſays he, who have examined the influence of atmoſpheric air on germination, have perceived, that when ſeeds are placed in contact with water and pure azotic gas they do not germinate; and that there is a production of carbonic acid, which, mixing itſelf with the azotic gas, increaſes the volume of the atmoſphere of the plant. They have ſeen that, when oxygen gas is ſubſtituted in the preceding experiment

experiment for azotic gas, there is alſo a production of carbonic acid gas; but that the atmoſphere of the plant decreaſes, and that the oxygen gas is abſorbed. He made ſeveral experiments to diſcover what takes place in theſe operations. The following are his concluſions:

1. The atmoſpheric oxygen gas is not abſorbed by the ſeed in the act of germination, as ſeems hitherto to have been admitted, but is employed merely to form carbonic acid gas with the carbon of the ſeed.

2. The ſeed in germination does not, by the contact of the atmoſpheric air, form carbonic acid gas from its own ſubſtance, but only furniſhes one of the conſtituent parts of that gas, *viz.* carbon.

3. It furniſhes the oxygen and carbon from its own ſubſtance in the carbonic acid gas, which it produces when it is in contact only with water and pure azotic gas.

Though the action which the vegetation of plants exerciſes on atmoſpheric air has been examined by a great number of philoſophers, much on this head is ſtill wanting. Spallanzani, who has been lately ſnatched from the ſciences, has alſo examined this ſubject. He concludes from his experiments:

1. That the leaves and tops of vegetables, when the rays of the ſun dart upon them, increaſe the proportion of the oxygen gas of the atmoſpheric air.

2. That this augmentation is not ſo conſiderable as has been believed.

3. That the ſame parts of vegetables diminiſh the oxygen gas during the night, and cloudy days, by transforming it continually though ſlowly into carbonic acid.

4. That the flowers, whether in the ſun or ſhade, have more power to diminiſh the quantity of vital air or oxygen gas.

5. That fruit have the ſame effects in this reſpect as flowers.

Delaville has examined ſeveral plants which afforded him ſugar; ſuch as the mallow, digitalis purpurea, cabbage, the leaves of the artichoke. The beet-root gave alſo a large quantity.

Deſfontaines has publiſhed his excellent memoir on the ſtructure of the monocotyledons, or plants with one ſeminal leaf, ſuch as palms, aſparagus, ruſhes, &c. He has ſhown that

that the whole of the interior of theſe plants is compoſed of the medullary part, in the middle of which are a few longitudinal fibres. Theſe vegetables have no ſolidity but at the ſurface, where the fibres are collected and united; whereas in the dicotyledons the ſurface is compoſed of an epidermis, which has little ſolidity, while the interior has a great deal.

Though the green matter which vegetates in water has already been the object of much reſearch to philoſophers, Senebier has thought it worthy of being ſubjected to a new examination. He informs us, that it was known to Lahire, Leuenhoeck, and Homberg. Adanſon gave it the name of *tremella conferva gelatinoſa, omnium tenerrima, minima, aquarum limo innaſcens.* Prieſtley, Ingenhouz, Senebier, Girod-Chantram, made a variety of experiments and obſervations on this ſingular ſubſtance. Felix Fontana believes it to be a kind of polypier, that is the habitation of ſmall inſects, which produce it as other inſects produce coral. This is the opinion alſo of Ingenhouz and Girod-Chantram; but Senebier is of a different opinion. Having made reſearches reſpecting the manner in which this green matter is produced in the water, he found, 1. That it was never produced in water kept in obſcurity: 2. That a great deal of time was requiſite to produce it in diſtilled water, and that it was neceſſary that the water ſhould be long expoſed to the air: 3. That water into which he had put earth, was more favourable than any other to the production of this green matter: 4. That none of it was formed in a veſſel of water covered with a ſtratum of oil.

To aſcertain the manner in which it is formed, he put glaſſes, on which ſome of the green matter had been, into veſſels of water, and perceived in the water, ſome days after, animalcula without green matter. The green matter then appeared, and he ſaw the animalcula penetrate into it, and give it movement. At other times he ſaw the green matter without animalcula. He obſerved in this green matter a very diſtinct pellicle, ſimilar to that of vegetables. This pellicle appeared to him to abſorb the carbonic acid gas which is in the water; to decompoſe it; to abſorb the carbon; to nouriſh itſelf; and to ſuffer the oxygen gas to be diſengaged.

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This pellicle appeared to be the fundamental body of the green matter; it is a kind of net-work, or tiſſue.

He obſerved alſo, with great care, the animalcula generally found in the green matter, and it appeared that they were not different from thoſe of common infuſions. This much however is certain, that the ſame animals are not always found in the green matter. He mentions the experiments of Muller on infuſion animalcula, and ſhows, that the ſame kind almoſt are found in the green matter. He ſhows further, that the green matter, examined with the microſcope, exhibits nothing that can be conſidered as a polypier, or neſt of ſmall animalcula. From all theſe obſervations he concludes it to be probable, that the green matter is a real vegetable analogous to the *ulva inteſtinalis*, or *noſtoch*; that the animals moſt frequently found with it do not belong to it, ſince the green matter may exiſt without animalcula; and that theſe animalcula are often found without the green matter: ſo that, in every reſpect, the green matter and animalcula appear to be abſolutely independent of each other: the green matter muſt be a plant on which the animalcula feed.

The green matter, kept in water in an obſcure place, ſeems to diſſolve. It becomes gray, white, and gives no more air when expoſed to the ſun. A chemical analyſis of the green matter proves alſo that it is a vegetable, for he extracted from it gum, reſin, and a portion of green colouring matter: a ſmall quantity of ammonia has indeed been procured from it, but ſeveral plants, when analyſed, give the ſame; and beſides, this green matter almoſt always contains the remains of animalcula and other animals, which might have furniſhed ammonia. His concluſion is, notwithſtanding every probability to the contrary, that this green matter is a plant: further obſervations and experiments reſpecting it are neceſſary.

He next directs his reſearches to confervæ, and examines the opinion of thoſe who believe them to be the matter of zoophytes; that is to ſay, a kind of neſts, or madrepores, containing the inſects which form them. All his obſervations have proved to him that this opinion is not well founded, and he conſequently perſiſts in believing, that the confervæ, as well as the green matter, are real vegetables.

Girod-Chantram has made obſervations on different kinds of confervæ, but chiefly the *rivularis* and *fontan* . He maintains his firſt opinion, and believes theſe productions to be the habitation of animals.

Decandolle has examined, with Brogniard, the ſtructure of marine plants, ſuch as the *fuci*; he finds that they have a great affinity to the confervæ.

Morellot has given obſervations on the leaves of trees, with the ſigns which announce their being in full vigour, and the time when they ought to be collected for pharmaceutical and economical purpoſes. He ſhows that it is at the period when the plant is in flower that the leaves poſſeſs their full virtue. They drop when their particular life is terminated.

[To be continued.]

IV. *On the Effects of the Acetic or Acetous Ether, employed with Friction in the Rheumatiſm, Sciatica, and Gout.*

THE different changes of weather from cold to heat, and from dry to moiſt, which ſucceed each other ſo frequently and ſo rapidly, often give riſe to the rheumatiſm; a malady exceedingly painful, and for which medicine affords too few remedies. If acetic ether, therefore, as appears, ſpeedily allays the pains, and even cures them, the application of it is a new benefit to mankind, which ought to be made known that it may be brought into general uſe.

About twenty-five years ago, when the acetous ether was diſcovered in the laboratory of Count de Lauragais, it was not employed in medicine. In 1784, C. Sedillot jun. being tormented with the rheumatiſm, tried on himſelf this acid, pouring twelve or fifteen drops, at different times, on the part affected, which he immediately rubbed with his hand, to render the action of the remedy more penetrating. After this friction, he kept himſelf warm in bed: a perſpiration took place at the part which had been rubbed, and ſoon became general, and the pain was ſenſibly diminiſhed. Twelve hours after, a ſecond friction produced the like effects;

effects; and a third, after the ſame interval, made a complete cure. C. Sedillot ſays he repeated this experiment afterwards on a great many perſons, and that it always ſucceeded. He recommended it, therefore, to the notice of medical men in the Tranſactions of the Medical Society of Paris *.

C. Martin, phyſician to the hoſpital of Narbonne, and formerly phyſician to the army of the Eaſtern Pyrenees, has lately confirmed, in a memoir read before the Medical Society †, the properties aſcribed by C. Sedillot jun. to acetous ether. He employed it alſo, with friction, in ſeveral caſes of people tormented with the rheumatiſm, ſciatica, and gout. Among theſe caſes, he quotes one of a man fifty-five years of age, who had been long ſubject to rheumatic pains which had no fixed ſeat; and who, having been attacked with a violent ſciatica from the hip to the extremity of the foot, could obtain only very ſlight and momentary relief from all the other remedies, both internal and external, which were adminiſtered to him. Half an ounce of acetous ether was applied in friction, every twelve hours, over the whole of the part affected; and after each friction he kept himſelf warm in bed. After the third friction he found relief; and at the ſixth he was ſo well cured that he went next day to his country-ſeat, a league diſtant from the city, although three days before he had not been able to drag himſelf from one end of his chamber to the other without experiencing the moſt excruciating pain. Succeſsful caſes of this kind, communicated to the Society of Medicine at Paris by a regular practitioner, deſerve the attention of medical men, who ought to try the remedy in order to aſcertain whether its efficacy be ſuch as is here ſtated.

C. Sedillot conſiders acetous ether alſo as a ſedative much ſpeedier and gentler in its effect than opium: it does not tend, he ſays, like the latter, to impede the action of the organs. The following is the reſult of an experiment which he made with it on himſelf:—Six drops on a lump of ſugar

* No. X. Meſſidor, an. 5.

† See *La Recueil de la Société de Medicine*, Vol. VIII. No. 48, Germinal, an. 8.

produced no fenfible effect; next day, twelve drops induced a flight propenfity to fleep; and the day following, eighteen drops rendered this propenfity ftill greater. By thus adding fix drops to the dofe every fucceeding day, always with fugar, he fwallowed half a grain on the fixth day, which produced a profound tranquillity and neceffity of fleep.

It is recommended to thofe who employ this remedy to ufe pure acetous ether; but it is to be obferved, that it is not eafily met with in that ftate. The following is the procefs for preparing it, prefcribed by C. Sedillot:

Take equal parts (for example, a pound) of alcohol, and another of acetous acid. Diftil this mixture in a glafs retort, and the refult will be the acetous ether; which muft be rectified to free it from the fuperabundant acid which has paffed over with it in diftillation. For this purpofe put it into a glafs veffel, into which introduce a folution of the carbonat of pot-afh (falt of tartar): this alkali abforbs the acid, and the ether floats on the furface. It is then decanted, and rectified by a new diftillation in a glafs retort with a fuitable apparatus.

V. *On the Nature of the Colouring Principle of Lapis Lazuli.* *By* C. Guyton *.

CHEMISTS have long made that blue ftone, known under the name of *lapis lazuli,* an object of their refearch, with a view, in particular, to difcover the colouring fubftance which gives it fo high a value; on account of the fplendour it communicates to works in which it is employed, and of the ultramarine, fo much efteemed in painting, which is prepared from it. This colour was firft afcribed to copper; but the celebrated Margraf demonftrated the fallacy of this opinion, as he found in it only filex, fulphat of lime, lime, and a little iron. Some after him fufpected in it the prefence of the oxyd of cobalt; and others, fuch as Kinmann, a little fluoric acid: but all thefe conjectures, by a more accurate examination, were foon fhown to be falfe.

* From the *Annales de Chimie,* No. 100.

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The means of analyfis having, for fome years paft, been carried to a degree of perfection which could fcarcely have been expected, it was natural to think that the chemifts moft expert in this new art would not neglect to apply it to the folution of this important queftion. Among this number I fhall mention Mr. Klaproth, whofe labours have fo much enriched the chemiftry of minerals, and who has paid particular attention to all the blue-coloured foffils. In 1784 he publifhed experiments which demonftrate that what is called native Pruffian blue, a fubftance found in turfy foil, and which is often white before being expofed to the air, derives its colour only from a combination of iron and the phofphoric acid *.

Another mineral, remarkable for the fame colour, which has been fucceffively taken for fmalt, or the native blue oxyd of cobalt; for another kind of native Pruffian blue; and for a blue oxyd of copper, was difcovered at Vorau in Auftria. But it refults, from the examination of it by the celebrated chemift of Berlin, that the colour depends only on filex, argil, and iron; and though he difcovered that it refifted the action of the fire lefs than lapis lazuli, he is of opinion that it might be claffed among the number of its varieties, if it fhould be found to contain alfo lime †. This laft conclufion fhows that Mr. Klaproth had previoufly determined, with his ufual accuracy, the conftituent parts of the real lapis lazuli; and he indeed indicates them in the tenth article of his Refearches on Mineral Subftances; where we fee that the pureft lapis lazuli, called *oriental*, confifts of 46 *per cent.* of filex, 28 of carbonat of lime, 14·5 of argil, 6·5 of fulphat of lime, 3 of oxyd of iron, and 2 of water.

He rectified, therefore, the analyfis of Margraf, by adding argil; of which the latter made no mention, and which I fhowed, fifteen years ago, to be contained in it, by touching a polifhed piece of lapis lazuli with the fulphuric acid, which at the end of fome hours left very regular cryftals of alum, that remained on it. But by what principle can the oxyd of iron

* *Chemifche Annal.* 1784, p. 396.

† See *Beytrage zur kentnifs der mineral korper*, &c. Vol. I. p. 197, and *Annales de Chimie*, Vol. XXI. p. 144.

iron be tinged blue without a combination either with the pruffic or the phofphoric acid? Mr. Klaproth fays that he does not know *.

The experiments of which I am about to give an account feem to me to afford a folution of this important queftion: but before I prefent the proceffes and the refults, I ought, for the fake of perfpicuity, to give an account of fome labours, which paved the way for arriving at this conclufion. In the year 1780, when infpecting a pit in fearch of coal at Montolier, in the road from Dole to Poligny, I found, at the depth of 35 metres, a gypfeous bed containing zones of a beautiful very bright red colour. I gave a defcription and analyfis of it in the *Journal de Phyfique* for the month of December that year, and I concluded from my experiments that it was fulphat of lime coloured by the oxyd of iron.

The recent difcovery of feveral new metallic fubftances, fome of which had the property of giving colours of great intenfity, induced me to think that the foffil of Montolier deferved to be again examined with a view of fearching for one of thefe oxyds. For this purpofe, at the commencement of this year, I deftined a piece of it for the experiments in the analyfes of minerals, which form part of my courfe at the Polytechnic School. They were conducted with as much precifion as fagacity by C. Desormes, formerly a pupil in the laboratory of the fecond divifion. Having afcertained that this foffil contained no carbonat of lime, we took ten grammes of it, reduced to powder, which was put in a crucible and brought to a red heat. The colour became darker, and paffed to a yellowifh-brown, and there was a lofs in the weight of 2·23 grammes, or 22·3 *per cent.*

A. We digefted, at feveral times, the muriatic acid on the 7·77 that remained after calcination; they did not lofe their colour, and the acid took up only a very fmall portion of the iron.

B. We afterwards boiled the refiduum in a folution of the carbonat of pot-afh, but only a very fmall part was decompofed.

C. What remained was mixed with charcoal duft, and

* See his *Beytrage*, &c. Vol. I. p. 201.

treated in a crucible. A fulfure being formed, it was decompofed by the muriatic acid, which feized on the lime and the iron, while the filex remained mixed with the fuperabundant carbon.

D. The liquors arifing from the three operations were united, and then divided into two equal portions. From the firft we feparated iron, which was found to weigh 1·05 grammes; and I affured myfelf that it contained no other earth but lime. We drew from the fecond 8 decagrammes of lime. The whole liquor, therefore, contained, according to the proportions determined by Klaproth,

Oxyd of iron	- -	2·1 grammes.
Lime	- - -	1·6
Sulphuric acid	- -	2·91

E. It remained to examine the portion of earth left by the acid, and which was found mixed with the fuperabundant carbon. Here the operations began to prefent thofe unexpected phenomena, which, deviating from the ordinary courfe, inform the attentive chemift that he is advancing towards a difcovery. This refiduum was firft calcined in an open veffel to confume the carbon, but the filex remained black: it weighed 1·65. It was treated with pot-afh in a crucible of platina, and gave a fufed mafs of a fuperb blue colour. Water poured over it affumed the fame colour. The nitric acid made it entirely difappear. The filex, feparated by evaporating to drynefs, weighed no more than 0·86 grammes.

F. It now became of importance to know the effect of different re-agents on the nitric acid which had been poured over the mafs fufed in the crucible, with a view to difcover the fubftance that had given it thefe properties. The following are the refults of thefe trials:

1. With the pruffiat of pot-afh this liquor gave a precipitate of a yellowifh-green colour, which the addition of acids, inftead of converting into blue, made immediately difappear.

2. With the gallic acid there was no precipitate.

3. With fulphurated hydrogen there was no precipitate,

as

as might have been expected, looking only for iron; but it was proper thus to exclude the other metallic substances, which are precipitated by this re-agent.

4. With the hydro-sulphure of ammonia there was a beautiful green precipitate.

5. With ammonia, a white precipitate.

6. With pot-ash, a light blue precipitate.—The two last passed to yellow in drying.

Comparative experiments were made at the same time with a solution of the nitrat of iron, and the results were totally different.

G. That no doubt might be left respecting the nature of the substances, the presence of which might have had an influence in these results, synthesis was called in to the aid of analysis. Sulphure of iron was prepared in a direct manner; the nitric acid was poured over it in sufficient quantity, and the liquor, when filtered, was diluted with abundance of water, that the excess of the acid might no longer precipitate the sulphurated hydrogen which was poured over it. In this state the same re-agents which had been before employed presented all the same phenomena. One might have supposed that the sulphat of iron, (not oxydated,) in the same circumstances, would have given some analogous effects; but the prussiat of pot-ash produced only a white precipitate, as professor Proust had announced.

H. It was easy, after this, to conclude the analysis of the red sulphat of lime of Montolier: it confirmed what I had announced, that it depended only on the oxyd of iron; and, besides, determined with accuracy the quantities of the constituent parts as follows:

Sulphuric acid - - - - - -	29·1
Lime - - - - - - -	16·0
Oxyd of iron - - - - -	21·9
Silex - - - - - - -	8·6
Water carried off by the first calcination -	22·3
Loss - - - - - - - -	2·1
	100·0

But

But the termination of this labour opened a field for new refearches, of which it is time I fhould give an account alfo.

I. Obferving the blue colour which the fulphat of lime of Montolier had affumed with pot-afh, the effects of the reagents on the acid holding its iron in folution; and, above all, feeing the green precipitate formed by the pruffiats difappear by the addition of acid, C. Deformes recollected that he had obferved fimilar phenomena during fome experiments which he undertook laft year with C. Clouet on lapis lazuli. This was already a ftrong indication that this ftone contained fome other colouring metallic oxyd than that of iron. The queftion then was, to follow the coincidence of facts in all its circumftances, to determine the particular ftate in which this metal produces that beautiful blue compofition. Some experiments added to the obfervations already known refpecting the properties of lapis lazuli will give an idea of this coincidence.

K. Lapis lazuli may be brought to a red heat, and lofe as much as 0·2 of its weight without any fenfible alteration in its colour; but at a ftronger heat, fuch as that of an enameller's furnace, its colour paffes to grey. By ftill increafing the intenfity of the heat, it is reduced to a brownifh vitreous fcoria, and there is a decreafe of from 10 to 11 hundred parts of its weight.

L. When lapis lazuli is pulverifed, one fometimes perceives a fmell fimilar to that of mufk, and which argil and magnefia emit alfo when they are united with a little fulphur.

M. Lapis lazuli is deprived of its colour by the three mineral acids, but more or lefs fpeedily. This effect, by the nitric acid, is produced almoft inftantaneoufly: the muriatic acid is the next in order: the action of fulphuric acid is the floweft. The fame odour is often difengaged from it by thefe acids as by trituration.

If the nitric acid is concentrated, there is a production of nitrous gas; and, accidentally, of carbonic acid gas when the lapis lazuli contains carbonat of lime. The liquor tried by pruffiats gives a precipitate, the colour of which approaches that of Pruffian blue, but inclining fenfibly to green, and

which is deſtroyed by acids. The hydro-ſulfure of ammonia occaſions in it a green precipitate inclining to black. When the nitric acid is uſed diluted with water, there is a diſengagement of a little ſulphurated hydrogen. Pruſſiats then form in the liquor only a bright green precipitate, which acids cauſe immediately to diſappear. With the hydro-ſulfure of ammonia the precipitate is a beautiful green. If the lapis lazuli has been previouſly ſubjected to calcination, diluted nitric acid diſengages from it a little ſulphureous acid gas.

N. Theſe facts prove, not only that the lapis lazuli holds a little ſulphur, but they demonſtrate alſo the identity of the colouring principle of this ſtone, with every compoſition in which earthy ſubſtances are made to enter in combination with the ſulfure of iron, ſince we have ſeen (F, G,) the ſulphat of lime, holding iron, carried to the ſtate of ſulfure by carbon, and the ſulfure of iron, prepared in a direct manner, preſent the ſame phenomena under the ſame circumſtances.

O. Before I terminate this memoir I ſhall add ſome obſervations, which will be of utility to thoſe who may be diſpoſed to repeat theſe experiments.

The compoſition of every kind of lapis lazuli is not eſſentially the ſame: one may perceive very diſtinctly in ſeveral ſpecimens, even of that called the oriental, ſulfure of iron in cryſtals which have metallic brilliancy. Sometimes it is diſſeminated in ſmall particles; and it is this, no doubt, which has hitherto prevented the moſt accurate chemiſts from detecting the real colouring principle of this ſubſtance. They have ſeen the ſulphur as an accidental production foreign to the ſubject of the analyſis, without ſuſpecting that there exiſted *a blue ſulfure of iron.* It may readily be conceived that, in experiments of this kind, the greateſt care muſt be taken to chooſe fragments abſolutely free from every particle of pyrites or ſulfure of iron, of a yellow metallic appearance.

The preſence of this laſt ſulfure is not the only difference found between ſpecimens of lapis lazuli. Of three kinds ſubjected to examination, one contained, with cryſtalliſed ſulfure of iron and blue ſulfure of iron, only ſulphat of lime and ſilex. The ſecond, beſides theſe, contained barytes; and the third, abſolutely

abſolutely free from all mixture of pyrites, had in its compoſition argil and carbonat of lime ſimilar to that analyſed by Mr. Klaproth.

The cryſtals of alum, which were formed very ſpeedily, as already mentioned, on a beautiful plate of lapis lazuli, leave no doubt that there are ſome kinds in which a little pot-aſh may be accidentally contained. It will be proper, therefore, to ſearch for the colouring principle in what conſtitutes its real eſſence, without paying too much attention to theſe accidental varieties. We muſt not, however, believe that the affinity of earths, either with each other, or with the colouring principle itſelf, has any influence on the nature of the compound. A proof of the contrary here preſented itſelf, in a ſenſible manner, in one of the ſynthetic operations. Sulphat of lime charged with iron having been treated with charcoal-duſt, and then held in digeſtion in the nitric acid, the pruſſiat of pot-aſh at firſt only coloured the liquor green, without giving a precipitate: the addition of a ſolution of argil immediately produced a green precipitate, which was taken up by acids, and, under all circumſtances, exhibited the ſame phenomena as that obtained from the decompoſition of lapis lazuli.

The conſequences which appear to me to reſult from the facts announced in this paper, are as follows:

1. The ſulphat of lime of Montolier is coloured by a red oxyd of iron, which adheres ſo ſtrongly to ſilex as to reſiſt the action of acids.

2. This ſulphat, treated with carbon, gives birth to a ſulfure of iron, in which that metal is leſs oxydated; which being diſſolved in acids, does not by pruſſiats give Pruſſian blue, but a green precipitate, which acids deſtroy inſtead of heightening, and which retains the blue colour peculiar to it even in pot-aſh, and at that heat which is required for its fuſion in the dry way.

3. By operating on the ſulfure of iron prepared in a direct manner, you obtain a product which manifeſts the ſame properties in the ſame acids, and by the ſame re-agents.

4. Theſe phenomena are exactly ſimilar to thoſe exhibited by lapis lazuli ſubjected to the ſame operations.

 5. We

5. We may therefore form at pleasure the blue colouring principle of lapis lazuli, the difference in the natural production necessarily resulting from the slow combination of this principle with the earths and sulphat of lime alone excepted.

6. In the last place, the blue sulfure of iron is the real and sole colouring principle of all the varieties of the lapis lazuli, and probably of that mineral also known under the name of the blue stone of Vorau.

VI. *Account of certain Phenomena observed in the Air-Vault of the Furnaces of the Devon Iron-Works*; together with some practical Remarks on the Management of Blast-Furnaces. By Mr.* ROEBUCK, *in a Letter to Sir* JAMES HALL, *Bart. Communicated by Sir* JAMES HALL †.

I HAVE examined my memorandums concerning the observations I made on the condensed air in the air-vault of the Devon iron-works near Alloa; and, according to your request, I now transmit you an account of them; and also of an experiment I made, when a partner and manager of these works, in order to increase the produce of blast-furnaces.

The two blast-furnaces at Devon are of large dimensions, each being 44 feet high, and about 13 feet wide in the boshes, or widest part, and are formed on a steep bank, by two pits sunk in a very solid stratum of coarse-grained free-stone.

These pits were afterwards shaped and lined, in the usual manner of blast-furnaces, with common bricks and fire-bricks; and the hearth was laid with large blocks of the stone that had been dug out, and which serve the purpose of fire-stones. At the back of the two furnaces, next the bank, the air-vault is excavated, and formed by a mine drove in the solid rock, distant from the furnaces about 16 feet. The

* These iron-works are on the banks of the river Devon, which runs into the Frith of Forth near Alloa. They are three miles from Alloa, and eight from Stirling.

† From *Transactions of the Royal Society of Edinburgh*, Vol. V. part 1.

bottom

bottom of the air-vault is only about four feet higher than the level of the bottom of the furnaces. This vault has an aperture at one end to receive the air from the blowing machine, and has two at the oppoſite end, one of which receives the eduction-pipe, and the other is a door to give admittance occaſionally into the vault. As the rock is extremely cloſe and ſolid, the vault is dry, except that a little water ouzes very gently from the ſide next the bank in ſmall drops, and does not appear to exceed an Engliſh pint in 24 hours.

Theſe furnaces are provided with air, or blaſt, as it is termed, by the means of a fire-engine of the old, or Newcomen's conſtruction. The diameter of the ſteam cylinder is $48\frac{3}{4}$ inches; and the ſquare area of its piſton being about $1866\frac{1}{2}$ ſquare inches, the power of this ſort of engine cannot be rated at more than 7 lb. to the ſquare inch, amounting in all to about 13062 lb. This power was employed to work an air-pump, or blowing cylinder, of 78 inches diameter, and about 7 feet long. The number of ſquare inches on the piſton of the air-pump is 4778, and therefore this area, being multiplied by $2\frac{3}{4}$, will produce 13139; being a reſiſtance that nearly balances the above-rated power, and ſhows that the air, which was expelled from the air-pump, could not be condenſed more in the ordinary way of working than with a compreſſing power of about $2\frac{3}{4}$ lb. on each ſquare inch. As the engine was not regulated, at firſt, to make a longer ſtroke than about 4 feet 8 inches, only one furnace being uſed, the quantity of air expelled at each ſtroke of the machine was about 155 cubic feet, which it diſcharged through a valve into the air-vault about 16 times in a minute. When two furnaces afterwards were blown, the engine was regulated to work much quicker, and with a longer ſtroke. The air-vault is 72 feet long, 14 feet wide, and 13 feet high; and contains upwards of 13,000 cubic feet, or above 80 times the contents of the air-pump. The top, ſides, and bottom of this vault, where the leaſt fiſſure could be diſcovered in the beds of the rock, were carefully caulked with oakum, and afterwards plaſtered, and then covered with pitch and paper. The intention of blowing into the

the vault is to equalise the blast, or render it uniform, which it effects more completely than any machinery ever yet contrived for the same purpose. The air is conducted from the vault by the eduction-pipe, of 16 inches diameter, into an iron box or wind-chest, and from this it goes off to each furnace in two smaller pipes that terminate in nozzles, or blow-pipes, of only $2\frac{1}{2}$ to $\frac{3}{4}$ inch diameter at the tweer of the furnace.

When the furnace was put in blast, after having been filled with cokes, and gently heated for more than six weeks, the keepers allowed it to have but little blast at first, giving it a small blow-pipe of about $2\frac{1}{4}$ inch diameter, and likewise letting off a very considerable quantity of air, at the escape, or safety-valve, on the top of the iron wind-chest; as it is a received, though erroneous opinion among them, that the blast must be let on very gradually for several months. From the construction of this valve it was impossible to ascertain the exact proportion of the blast they thus parted with, but I believe it was very considerable. The consequence was, that the furnace, after it had been in blast for several days, never seemed to arrive at its proper degree of heat, but was always black and cold about the tweer in the hearth, and appeared in danger of choaking, or gobbing, as it is termed.

After various experiments, tried in vain, by the keepers and the company's engineer, and others, (indeed they tried every thing, except giving the furnace a greater quantity of air, which, as I afterwards ascertained, was all that it wanted,) they concluded that the air-vault was the cause of the whole mischief; and, to confirm their opinion, they said they had now discovered that water was, in considerable quantities, driven out of the air-vault through the blow-pipe, which cooled the furnace; and they insisted, that the power of the engine was such as to force water out of the solid rock; so that this method of equalising the blast never would succeed. The other managing partner was so much alarmed by these representations, that he began to consult with the engineer, and others, about finding a substitute for the air-vault at any expence.

As the plan of the blowing apparatus had been adopted at my

my recommendation, and was now ſo loudly condemned on account of the water, I had other motives, than mere intereſt, for trying to become better acquainted with the phenomena attending it. I accordingly determined to go into the air-vault, and to remain encloſed in the condenſed air while the engine was blowing the furnace. It is an experiment that perhaps never was made before, as there never exiſted ſuch an opportunity. I could not perſuade the engineer, or any other of the operative people about the work, to be my companions, as they imagined that there was much danger in the experiment. Mr. Neil Ryrie, however, one of the clerks of the Devon company, had ſufficient confidence in my repreſentations to venture himſelf along with me.

The machine had been ſtopped about two hours previous to our entering the vault, and we found a dampneſs and miſtineſs in it, which diſappeared ſoon after the door was ſhut faſt upon us, and the engine began to work in its uſual manner. After four or five ſtrokes of the engine, we both experienced a ſingular ſenſation in our ears, as if they were ſtopped by the fingers, which continued as long as we remained in the condenſed air. Our breathing was not in the leaſt affected. I had no thermometer with me, but the temperature of the air felt to us the ſame as that without the vault. Sound was much magnified, as we perceived, when we talked to each other, or ſtruck any thing; particularly the noiſe of the air eſcaping at the blow-pipe, or waſte valve, was very loud, and ſeemed to return back to us. There was no appearance of wind to diſturb the flame of our candles; on the contrary, I was ſurpriſed to find, that when we put one of them into the eduction-pipe, which conveys the wind from the vault to the furnaces, it was not blown out. There was not the ſmalleſt appearance of any drops of water iſſuing out of this pipe. The ouzing and dropping of water from the ſide of the rock next the bank, ſeemed the ſame as before the condenſation was made in the vault. In ſhort, every thing appeared, in other reſpects, the ſame as when we were in the common atmoſphere. Having remained about an hour in the condenſed air, and ſatisfied ourſelves that no water, during that time, that we could in the leaſt diſcover, was agitated

agitated and forced out of the rock and vault by the power of the blaſt, as was imagined and inſiſted on, we gave the ſignal to ſtop the engine. As ſoon as it ceaſed to work, and the condenſation abated, and before the door of the vault was unſcrewed, *the whole vault, in a few ſeconds, became filled with a thick vapour, ſo that we could hardly ſee the candles at four or five yards diſtance.* The door being now opened, the work-people, anxious to know our ſituation, and what had occurred, came into the vault, and prevented any further obſervations. I now endeavoured to account for this curious appearance of the water, which only ſhowed itſelf occaſionally, in very ſmall quantities, at the tweer, and at a hole I ordered to be made in the bottom of the wind-cheſt to collect it more accurately; for it never was obſerved, but either when the engine, after working ſlowly, was made to work quicker, or, after having been ſtopped for a few minutes, was ſet to work again.

I conſidered the vapour which we had diſcovered in the vault to ariſe from the moiſture of the ſide of the rock next the furnace, which being expelled by the great heat of the furnace, and converted into vapour, was able to force its way through the pores of the rock into the vault; but that being in a manner confined within the rock, by the preſſure of the condenſed air, it found itſelf at liberty to come into the vault only when the condenſation abated conſiderably, or was totally removed by the going ſlow, or ſtopping of the engine. It alſo occurred to me, that the air, in a ſtate of condenſation, might poſſibly be capable of holding a greater quantity of water in ſolution, which might precipitate ſuddenly into vapour or miſt when the condenſation abated. I imagined, therefore, that the very ſmall quantities of water we at times diſcovered, proceeded from nothing elſe but this vapour in its paſſage to the furnace along with the blaſt, being condenſed into water, by the coolneſs of the eduction-pipe and iron wind-cheſt. The quantity of water did not appear to amount to a gallon in twenty-four hours.

A few days after I had made this experiment, the water ceaſed entirely to make its appearance, either at the tweer or at the hole in the wind-cheſt; but the furnace did not come into

into heat for a long while after, and indeed not till the keepers let much more air into it by a larger blow-pipe, and allowed lefs air to efcape at the fafety valve. It is probable that the rock was now become perfectly dry by the continued heat of the furnace.

My experiment had the good effect to remove all the prejudices againft the plan I had adopted of blowing the furnaces, and likewife prevented the other partner from laying out a large fum of money, by ftopping the works, and altering the blowing machinery. Indeed, it has fince been admitted, by all who have feen it at work, to be the moft fimple and effective method of equalifing the blaft of any yet put in practice.

This experiment led me, fome time afterwards, to apply a wind-gauge that I contrived, to afcertain precifely the ftate of the condenfation of the air thrown into the furnaces. I found that a column of quickfilver was raifed five inches; and fometimes, though feldom, fix inches; and, in the interval of the return of the engine to receive air into the air-pump, it fell only half of an inch. At this time only one furnace was worked. But when two furnaces were in blaft, the engine only raifed the mercurial gauge about four inches; becaufe the Devon company, for certain reafons, did not, while I continued a partner, think proper to allow the blowing machinery to be completed, by the putting to work their fecond boiler of twenty feet diameter for the fire-engine, according to my original defign, which, by adjufting the machinery, would have enabled us to blow two furnaces, with two boilers, with as much effect, in proportion, as one furnace with one boiler. This inftrument had the advantage of enabling the work-people to difcover the real power of their blaft, and know the exact condition of the air-valves, and the gearing of the blowing pifton; for, if thefe were not tight, and in order, (although the engine might, to appearance, be doing well, by making the fame number of difcharges of the air-pump as ufual *per* minute,) yet the wind-gauge would not rife fo high, and would fhow that there was an imperfection fomewhere, by reafon of a quantity of air efcaping at the valves, or pifton, that could not fo eafily otherwife be known.

This contrivance was confidered as of much ufe, and was afterwards always quoted in the company's journal books, to fhow the actual ftate of the blowing machine, in comparing the daily produce of the furnaces.

I hope you will not think me tedious, when I explain to you another experiment, which appears to me to be of confiderable importance to all manufacturers of caft iron.

I had reafon to conjecture, from my own obfervations on the effects of blowing machinery on blaft-furnaces, as well as from the knowledge I had acquired from my father, Dr. Roebuck, and from my communications with other experienced iron mafters, that a great part of the power of fuch machinery was mifapplied in general practice by throwing air into furnaces with much greater velocity than neceffary; and that, if this velocity was, to a certain degree, diminifhed, the fame power, by properly adjufting the blowing machinery, of whatever nature, would be capable of throwing into the furnace a proportionally greater quantity of air. For, "*Since the quantities of any fluid, iffuing through the fame aperture, are as the fquare roots of the preffure*;" it follows, that it would require *four* times the preffure, or power, to expel *double* the quantity of air, through the fame aperture, in the fame time: but if the area of the aperture was doubled, then the quantity of air expelled by the fame power, and in the fame time, would be increafed in the ratio of the fquare root of 2 to 1, though its velocity would be diminifhed exactly in the fame proportion. Again: I confidered that the quantity and intenfity of heat produced in blaft-furnaces, and confequently its effects in increafing the produce, might be only in proportion to the quantity of air decompofed in the procefs of combuftion, without regard to its greater velocity; that is to fay, whether or not the fame quantity of air was forced, in the fame time, into the furnace through a fmall pipe, or through one of larger dimenfions; for, in attending to the procefs of a common air-furnace for remelting of iron, where there is a very large quantity of air admitted through the large areas between the bars, it is well known that a much greater intenfity of heat is produced than takes place in a blaft-fur-

nace,

nace, and yet the air does not enter into the fire through the bars with increafed denfity or great velocity. I therefore thought it probable, that increafing the *quantity* of air, thrown into the blaft-furnace, in a confiderable degree, although the *velocity or denfity* might be much lefs, would have the effect of increafing its heat, and operations, and produce. And as, from the principles above ftated, with regard to the machinery, I faw I could greatly increafe the quantity of air thrown into the furnace, by enlarging the diameter of the blow-pipe, and regulating the engine accordingly, without being obliged to employ more power, I was anxious to make this experiment.

A fyftem of management, of which I did by no means approve, was adopted by the other partners of the Devon company foon after the works were begun to be erected; and, in the profecution of it, they ordered their fecond furnace to be put in blaft, without permitting thofe meafures to be taken that were neceffary to provide and maintain a fufficient ftock of materials; and alfo, without allowing their blowing machine to be completed, according to the original defign, by the addition of its fecond boiler. As might have been expected, a trial of feveral months to carry on two furnaces, with only half the power of fteam that was neceffary, and an inadequate ftock of materials, proving unfuccefsful, the company, as a remedy, inftead of making up the above deficiencies, ordered one of the furnaces to be blown out, and ftopped altogether. This improper meafure, however, afforded me the opportunity of immediately putting in practice the plan I have mentioned.

When one of the furnaces was ftopped, the other continued to be blown by a blow-pipe of $2\frac{3}{4}$ inches diameter, and the produce of the furnace, for feveral weeks thereafter, was not 20 tons of iron *per* week at an average. The engine at this time was making about 16 ftrokes a minute, with a ftroke of the air-pump, about 4 feet 8 inches long; but when I altered the diameter of the blow-pipe, firft to 3, and immediately after to $3\frac{1}{2}$ inches diameter, and regulated the working gears of the engine, fo as to make a ftroke of 5 feet 2 inches long, and about 19 ftrokes in a minute, on an

average, the produce was immediately increased. It continued to be, on an average of nine months immediately after this improvement, at the rate of 33 tons of iron *per* week, of as good quality as formerly; for during this period, from the 21st of November 1795, to July 30, 1796, this one furnace yielded 1188 tons of iron. No more coals were consumed in working the blast-engine, or other expences about the blowing machine incurred, and therefore no more power was employed to produce this great effect. It is also of much importance to remark, that the consumption of materials, from which this large produce was obtained, was by no means so great as formerly. The furnace required very considerably *less fuel, less ironstone, and less limestone*, than were employed to produce the same quantity of iron by the former method of blowing; and according to the statements made out by the company's orders, as great a change was effected in the economical part of the business.

From the success of this experiment, so well authenticated, and continued for several months, I am led to be of opinion, that all blast-furnaces, by a proper adjustment of such machinery as they are provided with, might greatly and advantageously increase their produce, by assuming this as a principle, *viz.* "*That with the given power it is rather by a great quantity of air thrown into the furnace, with a moderate velocity, than by a less quantity thrown in with a greater velocity, that the greatest benefit is derived, in the smelting of ironstones, in order to produce pig-iron.*" However, it is by experiment alone, perhaps, that we can be enabled to find out the exact relations of power, velocity, and quantity of air requisite to produce a *maximum* of effect *.

But

* If Q be the quantity of a fluid, issuing in a given time through an aperture of the diameter D, V its velocity, and P the power by which it is forced through the aperture; then the area of that aperture being as D^2, the quantity of the fluid issuing in the given time will be as VD^2, or $VD^2 = Q$.

Again: this quantity multiplied into its velocity, will be as the *momentum* of the fluid expelled, or as the power by which it is expelled, that is, $V^2 D^2 = P$, or $VD = \sqrt{P}$.

Here, therefore, if D is given, V is as $\sqrt{P}$, as Mr. Roebuck affirms.

Also,

But an unfortunate difagreement among the partners of the Devon company put it out of my power to make further progrefs in this matter, by laying me under the neceffity, two years ago, of withdrawing myfelf entirely from the concern.

In order to illuftrate what is faid above, a ground plan of the air-vault and furnaces of the Devon iron-works is given in Plate X. of which the explanation follows:

Explanation of Fig. 1. *Plate* X.

A the air-vault, formed by a mine drove in the folid rock of coarfe grained freeftone. B the blowing cylinder. C the pipe that conveys the air from the blowing cylinder to the air-vault. D, the eduction-pipe, that carries the air from the air-vault to the iron wind-cheft. E, the iron wind-cheft, (about $2\frac{1}{2}$ feet cube,) in which is inferted a wind-gauge, reprefented in Fig. 3. F F, the two blow-pipes for each furnace, which terminate in apertures of $3\frac{1}{4}$ inches diameter at the tweers of the furnaces. G G, the two blaft-furnaces, placed in two pits funk in the folid rock. H H, the timps of the furnaces, from whence the caft iron is run off into the cafting room L L. O, the door to give occafional admittance into the air-vault. M, the excavation, in which is placed the blowing machine.

Explanation of Fig. 2.

A, the end of the wind-gauge, (about 12 inches long,) which is open to the atmofphere, being half filled with quickfilver. B, the end that is inferted in the iron wind-cheft, and expofed to the preffure of the condenfed air of the air-vault.

Alfo, becaufe $V = \frac{Q}{D^2}$, and alfo $V = \frac{\sqrt{P}}{D}$, $Q = D\sqrt{P}$, fo that, while P remains the fame, Q will increafe as D increafes, and V will diminifh in the fame ratio.

The problem, therefore, of throwing the greateft quantity of air into the furnace, with a given power, ftrictly fpeaking, has no *maximum*, but the largeft aperture of which the engine can admit muft be the beft. It is probable, however, that there is a certain velocity with which the air ought to enter into the furnace; this will produce a limitation of the problem, which, as Mr. Roebuck fuggefts, is not likely to be difcovered but by experiment. J. P.

VII. *Com-*

VII. *Communication from Dr.* BLACKBURNE *respecting Caloric, Light, and Colours.*

" SIR, Spring Garden, May 15, 1800.

" IT is now more than twelve months ſince I announced my intention of publiſhing ſome remarks concerning the uſe of the word *heat*, and the conſtitution of light. My avocations have not allowed me to fulfil my promiſe; and being ſtill uncertain when I may be able to finiſh for publication, I ſhall be much obliged to you to inſert in your reſpectable Journal the following brief reſults of my inveſtigation concerning light, which I conceive to be of more importance than thoſe concerning heat, which chiefly relate to verbal criticiſm. The proofs and reaſoning on which theſe reſults depend, will, I hope, be ſoon ſubmitted to the public.

" I am, &c.

" *Mr. Tilloch.* WILLIAM BLACKBURNE."

1ſt, Light is a compound reſulting from a peculiar combination of caloric and oxygen.

2dly, In all thoſe phenomena which have given occaſion to the idea that light is identical with, or a modification of, caloric, the manifeſtation of the latter principle is to be referred to the diſunion of the conſtituting principles of light. The caloric, therefore, which ſo frequently reſults from the application of light to various ſubſtances, iſſues from the decompoſition of light in various degrees.

3dly, The phenomena of colours are to be aſcribed to the different qualities of light, as containing caloric and oxygen in different proportions. The different proportions manifeſt themſelves in the circumſtances both of the decompoſition and the formation of variouſly coloured light.

4thly, The ſeparation of light by the priſm is to be regarded as a chemical decompoſition, not a phyſical or mechanical diviſion of light.

5thly, The changes which take place in the colours of different ſubſtances, as of plants in the proceſs of vegetation, of metals in that of oxydation, are owing to correſpondent

ſpondent changes which theſe ſubſtances undergo in their chemical action upon light.

6thly, The evaneſcence, or, as it is frequently termed, the abſorption, of light, is to be referred to the complete reſolution of this compound into its conſtituent parts.

VIII. *Memoir on Azot, and on the Queſtion, Whether it be a ſimple or a compound Body. By* CHRISTOPHER GIRTANNER, *M. D. of Gottingen*.*

THE moſt celebrated chemiſts have long known the important part which azot performs in all the operations of nature. Lavoiſier, Fourcroy, Berthollet, Van Mons, Guyton, Chaptal, Vauquelin, Prieſtley, Van Marum, Goettling, Wiegleb, Von Hauch, Paets, Van Trooſtwyk, Deiman, and ſeveral others, have endeavoured, with more or leſs ſucceſs, to ſtudy its nature; and it is to their labours united that we are indebted for a knowledge of its ſingular properties, which are very different from thoſe of the other aëriform fluids with whoſe baſes we are acquainted.

But it is in organiſed bodies that this ſingular principle ſeems to perform the moſt diſtinguiſhed part. In the reſearches I have made for twelve years, reſpecting the mechaniſm of life in animals and plants, I always found myſelf ſtopped by this too little known principle. In my experiments I ſaw it appear and diſappear, without being able to fix it, or to explain in what manner it had introduced itſelf into the body from which I extracted it. I began, therefore, to ſuſpect that azot was not a ſimple body, but a compound. I formed ſeveral conjectures, which my experiments proved to be falſe; and, deſpairing of ſucceſs, I had entirely given up purſuing this ſubject, when the diſpute which aroſe reſpecting the azotic gas drawn from the ſteam of water, induced me to turn my attention to it once more. This diſpute is not yet terminated, notwithſtanding all that has been ſaid for and againſt the converſion of ſteam into gas by

* From the *Annales de Chimie*, No. 100. This is the memoir announced in the preceding number of the Philoſophical Magazine, p. 216.

Goettling,

Goettling, Wiegleb, Von Hauch, Westrumb, Achard, Wurzer, Juch, Van Mons, Paets, Van Trooftwyk, and Deiman. It appears to me that this famous dispute has a great resemblance to many others mentioned in the annals of our science, and by which the most important points of the theory of chemistry have been fixed. Such was the dispute on the existence or non-existence of the carbonic acid in chalk, which occupied all the chemists of Europe for several years; and such was that respecting the existence or non-existence of oxygen in the red oxyd of mercury: a dispute in which I myself was engaged, and abused by the German chemists, and particularly Gren, who was exceedingly apt to become warm *.

Wiegleb, Goettling, and Von Crell, assert,

1. That the steam of water, in passing through ignited tubes, is converted into azotic gas.

2. That this change always takes place, and under all circumstances, provided the steam of the water is brought into contact with the ignited bodies.

3. That water is changed into azotic gas by combining itself with caloric.

4. That water is the ponderable base of azotic gas and of all the other gases.

5. That consequently the theory of Lavoisier is false.

The Dutch chemists, as well as Von Hauch, Juch, Van Mons, &c. maintain,

1. That the steam of water, in passing through ignited tubes, is not converted into azotic gas in any case whatever.

2. That the azotic gas obtained, has not been a production of the water, but has arisen from a part of the atmospheric air which passed through the tubes.

3. That consequently the theory of Lavoisier remains unshaken; and that the theory of phlogiston, or that of water, being the base of all the gases, is erroneous.

Being much interested in this dispute, I followed its progress with great attention; but I was sorry to see party

* All the opinions maintained by Gren were erroneous; but he had the merit of writing his *Systematisches Handbuch*, which is an excellent compilation. Gren was a good compiler, but a bad reasoner.

ſpirit introduced into it, and that it was carried on with aſperity on both ſides; that the contending parties diſputed not for the diſcovery of truth, but for victory; and that they were previouſly determined to diſcover nothing but what their particular theory required. This conduct prevented them from ſeeing the object under its real appearance: experiments were multiplied; each party denied thoſe of the oppoſite party; reſults entirely different were found, and inſtead of approaching, they receded ſtill further from each other. The only thing which intereſted me in this diſpute was truth. I am firmly perſuaded that the ſyſtem of Lavoiſier is agreeable to nature. Having heard of an experiment which I was told overturned this ſyſtem entirely, I immediately ſaid: Let us repeat and examine it; if the ſyſtem be falſe, we ought to abandon it as ſoon as poſſible, and not to wait till it abandon us. Let us not be attached to ſyſtems, but to truth; and when Nature ſpeaks, let us liſten to her voice in preference to that of a Stahl or a Lavoiſier, a Deſcartes or a Newton. Whatever may be the reſult of our experiments, we ſhall profit by them: as we run the riſque of loſing nothing but error, let us haſten to ſubject ourſelves to that loſs.

Such was the manner in which I reaſoned. I had learned from the hiſtory of chemiſtry, that in all diſputes in which two parties obtained contrary reſults from ſimilar experiments there was a miſtake in the mode of expreſſion, and that both at bottom were in the right; and I doubted whether this might not be the caſe in regard to the diſpute in queſtion. I propoſed, therefore, to reſolve the following points:

1. Is the ſteam of boiling water converted into azotic gas by paſſing through ignited tubes?

2. Under what circumſtances does this change take place?

3. What is the rationale of this production of azotic gas?

4. Are theſe experiments contrary, or not, to the ſyſtem of Lavoiſier?

I will freely confeſs, before I enter on this diſcuſſion, that the manner in which the production of azotic gas had been explained, by making it paſs from the external air through

the tubes, did not appear to me altogether satisfactory. I had, indeed, formerly adopted this explanation *; but I soon abandoned an opinion so contrary to every thing that we know of caloric. I am really sorry to see an opinion so improbable defended by chemists of the first rank; but the history of chemistry affords many instances of the like kind. Before the immortal Lavoisier had proscribed phlogiston, the Stahlians extricated themselves from their embarrassment in a manner absolutely similar. They put oxyd of mercury in a crucible, shut the crucible in the closest manner possible, and exposed it to a strong heat. On opening it after it had cooled, the mercury was found fluid. But as such a reduction, according to the doctrine of Stahl, could not take place without the intervention of phlogiston, the Stahlians were asked to explain this phenomenon so contrary to their doctrine. Their answer was, that the phlogiston had passed through the crucible to join itself to the mercury. Even Bergmann and Scheele were satisfied with this absurd explanation †; which proves that the spirit of system misleads the ablest men, and renders them ridiculous in the eyes of posterity, more enlightened, and less slaves to prejudice. I shall show that azot does not pass through the sides of tubes, and that phlogiston does not pass through crucibles. The experiments which Priestley made to prove that the air passes through earthen retorts, does not prove what he pretended to prove. He saw the retorts smoke on the outside, but the water, as he imagines, did not pass through: the exterior part of the earthen retort only attracted the water of the atmosphere.

As I propose, in a particular work on azot, to give a detail of the numerous experiments I have made to ascertain its nature, I shall confine myself at present to a general view of them, as well as of the results which I think myself authorised to deduce from them. I think, then, that I may safely assert, that azotic gas is obtained:

1. When water is boiled in an earthen retort unglazed in the

* *Anfangsgrunde der antiphlogistischen chemie*, second edition, p. 89, 90.
† *Scheele von luft und feuer*, edition of Leonhardi, p. 42.

the inſide, and when the ſteam is made to paſs through a tube of glaſs or any other ſubſtance.

2. When water is boiled in a glaſs retort which contains argil or alumine, and the ſteam is made to paſs through a tube of glaſs or of any other ſubſtance.

3. When common water is boiled in a glaſs retort, and the ſteam is made to paſs through an earthen tube.

4. When common water is boiled in a glaſs retort, and the ſteam is made to paſs through a glaſs tube which contains argil or alumine.

5. When an earthen tube, filled with water, is incloſed in a larger one of glaſs, with ſand between them; and the tube of glaſs in another of iron, with ſand between them, in the like manner, and the whole is expoſed to the fire *.

6. When water is boiled in a glaſs retort containing lime, and the ſteam of it is made to paſs through a tube of glaſs or of any other ſubſtance.

7. When water is boiled in a glaſs retort containing pounded quartz or ſilex, and the ſteam is made to paſs through a tube of glaſs or of any other ſubſtance.

8. The firſt experiment will equally ſucceed when the earthen retort is covered on the *outſide* with a metallic glazing.

9. The third experiment will alſo ſucceed when the earthen tube is covered on the *outſide* with a metallic glazing.

10. The fourth experiment will ſucceed, when, inſtead of argil, the tube is filled with lime or pounded quartz.

Only ſteam of water, but no azotic gas, is obtained:

1. When water is boiled in a glaſs retort, and the vapour is made to paſs through tubes of glaſs or porcelain.

2. When water is boiled in an earthen retort covered on the inſide with a metallic glazing, and the ſteam is made to paſs through tubes of glaſs or porcelain.

3. When water is boiled in a glaſs retort filled with pounded glaſs, and the ſteam is made to paſs through tubes of glaſs or porcelain.

* This is one of Prieſtley's experiments, which I have not repeated. See his Experiments and Obſervations on different Kinds of Air, *Birmingham* 1790, Vol. II. p. 418.

General Remarks.

To obtain azotic gas in the greateſt quantity, the water muſt be evaporated very ſlowly, and over a very gentle fire; and care muſt be taken not to increaſe the fire too much.

In every experiment of this kind, without exception, it may be obſerved, that when the laſt drop of water is evaporating the azotic gas ceaſes to be produced, though the fire be continued.

Reſults of the Experiments.

Such are the facts and plain ſtatement of the experiments, independent of all ſyſtem, of all explanation, and of all theory. It thence reſults:

1. That Meſſrs. Wiegleb and Goettling were right in ſaying that water was converted into azotic gas by the action of fire.

2. That they were wrong in maintaining that this change always takes place, and under all circumſtances, when the ſteam of the water is brought into contact with bodies brought to ignition in the fire.

3. That Mr. Wiegleb has not proved what he aſſerts, *viz.* that the converſion of water into gas is owing to a mere addition of caloric, and that water forms the baſe of all the gaſes.

4. That the Dutch chemiſts were wrong in advancing that the converſion of water into azotic gas never took place in any caſe whatever; and that the gas obtained aroſe from atmoſpheric air which had paſſed through the retorts and the tubes.

5. That there are certain circumſtances under which water is converted into azotic gas, and others where it is not; and that it is eaſy to reconcile the oppoſite parties.

The change of water into azotic gas by the action of caloric and of earths being aſcertained, the queſtion was, to find a ſolution of this problem. The manner in which I explain it is as follows:—I have obſerved, as well as Ingenhouz, Von Humboldt, and Van Mons, that moiſt earths are endowed with the property of abſorbing the oxygen of the atmoſphere at the common temperature. Beſides, I have obſerved a circumſtance, not mentioned by Von Humboldt,

 that

that they absorb oxygen in less time, and in greater quantity, when they are heated. I found, by other experiments, that earths take the same oxygen from the water; but that, for this purpose, a temperature higher than that of the atmosphere is required. Argil, argillaceous earth, or alumine, is that which takes up oxygen with the greatest avidity, and at a temperature far below that of boiling water; lime requires a higher temperature, and does not charge itself so much with oxygen; silex, before it absorbs oxygen, must be brought to a state of ignition in the fire, but afterwards it takes it up very rapidly. Baked argil unites itself also with oxygen, but it requires a higher temperature. Glazed argil does not absorb oxygen, the glazing being made of metallic glass, which has no action on oxygen.

Having made these observations, I did not find it difficult to explain the phenomena of the conversion of water into azotic gas. Recollecting the hypothesis which M. Mayer had ventured to start, a few years ago, on the nature of azotic gas, by supposing that it was a compound of oxygen and hydrogen, water converted into a gas *, I conceived a similar idea respecting it. As M. Mayer gave his hypothesis merely as an idea thrown out at hazard, and as he supported it with no chemical experiment whatever, I proposed to supply what he had left undone. Admitting this hypothesis, and reflecting on the singular property which earths have of absorbing the oxygen of water, I explained, without difficulty, the experiments above mentioned. They are the result of a double affinity. The oxygen of the water unites itself in part to the earth, which is converted into an earthy oxyd; the remainder of the oxygen in union with the hydrogen combines with the caloric, and forms azotic gas; consequently, *azot is water deprived of a part of its oxygen.*

This assertion is suppported by various experiments: but I shall confine myself to a few only, and shall reserve the rest to be mentioned in a second memoir, after I have repeated them.

1. Provide porcelain tubes, and try them by transmitting through them the steam of boiling water, which will pass in

* Gren's *Journal der Physik*, Vol. V. p. 382.

vapour

vapour without the least particle of gas except the air contained in the retort. After you have ascertained in this manner that the water is not changed into gas in these tubes, to prevent the objections of those who imagine that the external air passes through the tubes, fill one of them with filings of tin and put it into the fire, which you must take care to keep up. Then make the steam of water to pass through it. In the pneumatic apparatus you will obtain azotic gas mixed with oxygen gas. The tin is changed into an oxyd. This experiment, which was made by M. Von Hauch, may be easily explained from my principles. The tin takes from the water only a part of the oxygen it contains; the rest remains in union with the hydrogen, and forms azot.

2. By transmitting the steam of water over lead, in the same manner as in the preceding experiment, you will obtain, according to M. Von Hauch, the same result. At the commencement of the operation the oxyd of the lead passes under the bell with the gas and the steam of the water, and the metal then appears under the form of a very fine powder. The azotic gas obtained is in proportion to the oxygen gas almost as 64 to 36.

3. By transmitting, in the same manner, the steam of water through a tube filled with antimony, you obtain a mixture of azotic gas and oxygen gas. There will be 89 parts of the former, and 11 of the latter.

4. A porcelain tube was filled with black oxyd of manganese, and the tube exposed to a very strong heat for more than two hours, until the oxyd had entirely ceased to furnish oxygen gas. The steam of water was then made to pass over this oxyd deprived of the greater part of its oxygen. At first, oxygen gas pretty pure was obtained, and then azotic gas. This experiment of M. Von Hauch is very instructive. The manganese evidently absorbed, first the hydrogen, and then a part of the oxygen of the water.

5. The steam of water was made to pass through the same tube, filled with the same manganese which had served for the fourth experiment. Azotic gas was obtained; and the fire being continued for three hours, the disengagement of the azotic gas continued as long as the steam of the water

was

was made to pass. When no more steam was transmitted, the disengagement of the azot ceased; but it recommenced as soon as the water was again boiled, and new steam began to pass over the manganese. This experiment was repeated six days successively, each day for three hours, and always with the same success. When the operation was ended, the manganese was found cemented to the porcelain tube in such a manner that it could not be separated.

6. Dr. Pearson analysing water by an electric spark, always obtained azotic gas, besides the two gases of which water is composed.

7. The same gentleman burning, in a tube hermetically sealed, a mixture of oxygen and hydrogen gas by means of an electric spark, obtained water and azotic gas.

8. Dr. Priestley observed, that oxygen gas which had remained in contact for some time with the purest distilled water was in part changed into azotic gas. I have proved this observation, and I found 0.1 of azotic gas in the oxygen gas.

9. A mixture of hydrogen gas and nitrous gas, which remains for some time in contact with water, no longer burns, and is found changed into atmospheric air; which I explain by supposing that the hydrogen combines itself with a part of the oxygen of the nitrous gas, or of the water, and is converted into azotic gas. This experiment, which was made by Mr. Link, with me did not succeed.

10. Dr. Priestley found that hydrogen gas, which he had kept for a long time in contact with water, was entirely changed into azotic gas*. This experiment does not always succeed. It succeeded four times with Priestley. It is, no doubt, necessary that the water should contain oxygen.

11. In burning a mixture of eleven cubic inches of hydrogen gas and one inch of oxygen gas, azotic gas is obtained. This experiment was made by M. Yelin, but with me did not succeed.

12. When the steam of water is made to pass through a gun-barrel which has been before employed several times for the same kind of experiments, and has been entirely oxydated

* See Priestley's work before quoted, Vol. I. p. 230.

in the inside, no hydrogen gas is obtained, but azotic gas, as the iron is no longer able to take up any of the oxygen presented to it by the water. This is an experiment of M. Yelin, and was confirmed to me by M. Mayer.

13. An experiment made by Mr. Lampadius appears to me to prove, in a very satisfactory manner, the presence of oxygen in azotic gas. He fused arsenic in the purest azotic gas prepared by the combustion of phosphorus. The metal was sublimated, and at the end of the experiment it was found that it had been in part converted into oxyd of arsenic.

14. In the combustion of two gases to produce water, when the quantity of hydrogen is too great, nitric acid is obtained.

15. The following experiment, described by Scheele, appears to me a new proof that azot is nothing but oxydated hydrogen. The following are the words of this celebrated chemist *:—"I filled a bladder with air obtained from iron filings dissolved in the vitriolic acid, and inhaled this air. Having inspired it twenty times, I found myself obliged to desist. Having recovered a little, I exspired, as far as possible, all the air contained in my lungs, and then again respired the inflammable air. After ten inspirations I could inspire no more. The air, on being examined, was no longer inflammable; but, however, did not render turbid lime water. In a word, it was corrupted air, (azotic gas)." It may be perceived that in this experiment the pure hydrogen gas combined itself in the lungs with the oxygen gas, which remained after the preceding inspirations of atmospheric air, and formed there azotic gas.

16. For another experiment, which appears to me to corroborate my opinion respecting the nature of azotic gas, we are indebted to Mr. Henry, of Manchester. It was repeated by him several times, and always with the same success †. His explanation of this phenomenon, which is very different from mine, because he believes azot to be a simple body, may be found in the work below quoted. His experiment is as follows:—In a bent tube of glass he mixed, in a mer-

* *Von luft und feuer*, p. 136.

† Scherer's *Algemeines Journal der Chemie*, Vol. I. p. 9.

curial

curial pneumatic apparatus, 94·5 meafures of carbonated hydrogen gas, and 107·5 meafures of very pure oxygen gas (obtained from the oxygenated muriat of potafh). This mixture, forming 202 meafures, was reduced, by an electric explofion made to pafs through it, to 128·5 meafures, and then, by lime-water, to 54·0: a folution of the fulphat of potafh diminifhed the remainder to 23 meafures. In this experiment, therefore, 23 meafures of azotic gas were produced by an electric explofion, the oxygen uniting itfelf to the hydrogen.

17. Of all the known bodies, zinc, if I am not miftaken, is that which unites eafieft with oxygen; it takes it from almoft all other bodies, and this renders it exceedingly proper for enabling us to difcover the fmalleft quantities of oxygen. It was by means of zinc in particular that I was able to feparate the oxygen of the muriatic acid from its bafe: I employed it alfo to make the lateft analyfis of ammonia. If filings of zinc be mixed in a retort with concentrated liquid ammonia, the retort being made to communicate with a pneumatic apparatus; and if it be kept in digeftion for feveral days, taking care not to increafe the fire too much, the ammonia will be decompofed. In the retort you will obtain oxyd of zinc, and under the pneumatic apparatus hydrogen gas in confiderable quantity, mixed with a fmall portion of ammoniacal gas and azotic gas not decompofed. It is eafy to prove that it is not the water with which the ammonia has been diluted that could furnifh the hydrogen gas obtained, becaufe the hydrogen is obtained in too large quantity, and the azot in too fmall, to leave any doubt in regard to the decompofition of the latter.

Such are the experiments from which we may, I think, conclude that azot is a compound of hydrogen and oxygen. In a fecond memoir I fhall make known feveral other experiments no lefs decifive, but which require to be repeated before they can be fubmitted to the examination of the able and accurate chemifts to whom this paper is addreffed. Azot, then, if I am not miftaken, being a body compounded of hydrogen and oxygen, it thence follows, that the atmofphere is

 not,

not, as hitherto believed, a mixture of oxygen gas and azotic gas, but rather a mixture of oxygen gas and hydrogen, and, if I may be allowed the expreſſion, water in the form of gas. When by chemical experiments, which very improperly have been called *eudiometric*, the oxygen is ſeparated from the hydrogen, this ſeparation never can be effected entirely or completely: a part of the oxygen remains united to the hydrogen, and forms that chemical combination which we call azot, and which we obtain by the above experiments. Oxygen, ſo indiſpenſably neceſſary for ſupporting the life of organiſed beings, is, by its combination with hydrogen, converted into azot, which not only is unfit for maintaining life, but is a real poiſon, on account of the affinity it has for oxygen, and the avidity with which it takes it from organiſed bodies.

Oxygen has ſo great an affinity for hydrogen, when both are found mixed in the atmoſphere, that it is very difficult to ſeparate them entirely: for this reaſon, the analyſis of azot has been attended with great trouble. When charcoal, ſulphur, a taper, and metals, ceaſe to burn in atmoſpheric air, and when animals expire in it, it ſtill contains a pretty large portion of oxygen. Phoſphorus burns in it exceedingly well, and for a very long time; and even when phoſphorus ceaſes to burn there always remains a ſmall quantity of oxygen united to the hydrogen; that is to ſay, there ſtill remains azot. Atmoſpheric air, however, as I have ſeveral times obſerved, may be deprived of almoſt all its oxygen, and the analyſis of it may be rendered almoſt complete, by heating phoſphorus in it for ſome time. Phoſphorated hydrogen gas will then be obtained by the converſion of a part of the azot into hydrogen.

It reſults from theſe experiments, that eudiometry, ſuch as it exiſts at preſent, is founded on erroneous principles. The azot obtained by theſe experiments being always a product of the operation, and not having previouſly exiſted under the form of azot in the air ſubjected to examination, Von Humboldt, who is fond of drawing general concluſions from individual facts, ſeems to have been deceived when he aſſerts, that earths might be employed to determine the quantity of

azot

azot contained in atmospheric air. Earths do not indicate the azot contained in atmospheric air; they convert that air into azot.

Cultivated earth being in contact with the atmosphere absorbs its oxygen and forms azot. In the polar regions, and on the summits of the Alps, where the earth is always covered with snow, the atmospheric air contains a greater quantity of oxygen than in the southern countries or in the plains, as the snow prevents the air from coming in contact with the earth.

Since the constituent parts of azot are now known, we might write a new theory of the art of making saltpetre. The *Annales de Chimie* * contain some very valuable observations on this subject; for example, the following:— "The earth taken up from deep subterraneous places well secured from the light, such as cellars, requires only to be exposed to the air a few days to produce abundance of saltpetre. It is worthy of observation, that such earth does not furnish an atom of nitrat when taken from the damp and obscure places where it was formed, and that it is only by the combination or combustion of the azot of the earth by the oxygen of the atmosphere that this salt is produced." The explanation given of this interesting phenomenon in the same work †, is a proof how far we were from the truth before the nature of azot was better known.

As lime absorbs oxygen with avidity, we see the reason of the insalubrity of apartments the walls of which have been recently whitened.

The following bodies are combinations of hydrogen with oxygen in different proportions: azot, the gaseous oxyd of azot, nitrous gas, the nitrous acid, the nitric acid, the muriatic acid, the oxygenated muriatic acid, the nitro-muriatic acid, water, atmospheric air, ammonia. I hope to be able soon to prove that to this list we ought to add potash, soda, and sulphur. Phosphorus appears to me to be hydrogen in the purest state with which we are acquainted with it; but this I am far from being able to prove. In regard to the

* Vol. XX. p. 313. † Page 314.

analysis of fixed alkalies, it has been effected completely. As I do not intend to enlarge on this subject in the present memoir, I shall only mention one of those experiments which are conclusive. When alkali is fused with silex for the purpose of making glass, you analyse the alkali. The hydrogen escapes under the form of a gas, and the oxygen combines itself with the silex, glass being nothing else but an oxyd of silex. Too much oxygen, however, must not enter into the composition, as it would render it less transparent: this is the reason why glass-makers add substances greedy of oxygen, as manganese.

Having communicated to M. Mayer the result of my experiments, by which I so evidently confirmed an idea thrown out by him at hazard, and of which he has the merit of being the author, this learned philosopher sent me a short memoir, of which the following is an extract:—"I am inclined to believe," says he, "with Mr. De Luc, that the evaporation of water, such as effected by nature on a large scale, is a real conversion of water into air. It is indeed true, that we have never yet been able in our laboratories to convert water into air by evaporation; but the reason of this is, that we are unacquainted with the part which both light and electricity perform in evaporation in general. It appears to me probable, however, that the ponderable parts of atmospheric air, that is to say, oxygen and azot, have no other source than from the water with which the surface of our globe is covered. The very small quantity of oxygen gas which vegetables exhale by the influence of the solar light, is far from being able to make good the enormous consumption of oxygen which daily takes place in our atmosphere so many different ways: but by supposing, according to this theory, that 100 grains of water are converted by the secret process of nature into 100 grains of atmospheric air, that is to say, into a chemical mixture of oxygen and hydrogen, we may find, by a very simple calculation, in what proportion the oxygen and hydrogen combine to form the azot which we find in the atmosphere. We must, however, keep in view, that what we call azot is not always of the same nature, and that there is

considerable

conſiderable variation in the proportions of its conſtituent principles *.

"I ſhall call the water W, the oxygen O, the hydrogen H, the ponderable part of atmoſpheric air L, and the ponderable part of azotic gas S.

$$\text{Then } 100\,W = 85\,O + 15\,H.$$

"But a cubic inch of atmoſpheric air is a mixture of $\frac{1}{4}$ cubic inch of oxygen gas and $\frac{3}{4}$ cubic inches of azotic gas; therefore,

$$1\,L = \tfrac{1}{4}\,O + \tfrac{3}{4}\,S.$$

"One inch of atmoſpheric air weighs 0·46 grains, one of oxygen gas 0·51 grains, and one of azotic gas 0·44 grains; conſequently,

$$0{\cdot}46\,L = \tfrac{0{\cdot}51}{4}\,O + \tfrac{3}{4}\,0{\cdot}44\,S.$$
$$1{\cdot}84\,L = 0{\cdot}51\,O + 1{\cdot}32\,S.$$
$$184\,L = 51\,O + 132\,S.$$
$$100\,L = 27{\cdot}8\,O + 72{\cdot}2\,S.$$

"Azotic gas being a compound of oxygen and hydrogen,

$$S = x\,O + y\,H; \text{ therefore,}$$
$$100\,L = (27{\cdot}8 + 72{\cdot}2\,x)\,O + 72{\cdot}2\,y\,H.$$

"But nature converts 100 grains of water into 100 grains of atmoſpheric air; conſequently,

$$100\,W = 100\,L; \text{ then,}$$
$$27{\cdot}8 + 72{\cdot}2\,x = 85$$
$$72{\cdot}2\,y = 15$$

"Therefore $x = 0{\cdot}79$, and $y = 0{\cdot}21$ nearly.

$$S = 0{\cdot}79\,O + 0{\cdot}21\,H, \text{ or } 100\,S = 79\,O + 21\,H.$$

"That is to ſay, 100 grains of azotic gas are compoſed of 79 grains of oxygen and 21 grains of hydrogen."

Having applied this ingenious mode of calculation, employed by M. Mayer, to the other oxyds of hydrogen, I had the following reſult:

If N be the nitric acid, we know by experiment that

$$100\,N = 79{\cdot}5\,O + 20{\cdot}5\,S.$$

* This is a very important point, to which M. Mayer has directed our attention. It will be neceſſary to make a great number of very accurate experiments to determine the different degrees of the oxydation of hydrogen, and to diſtinguiſh the different gaſes hitherto comprehended under the general name of *azotic gas*.

Now,

Now, instead of S let us substitute its value found by the preceding calculation, and we shall have

$100\ N = 79{\cdot}5\ O + 20{\cdot}5\ (0{\cdot}79\ O + 0{\cdot}21\ H) = 95{\cdot}7\ O + 4{\cdot}3\ H$ nearly.

100 Grains of nitric acid contain, therefore, nearly 96 grains of oxygen and 4 grains of hydrogen.

The same mode of calculation gave me also the following results:

100 Parts of ammonia = 63·72 oxygen + 36·28 hyd.
100 Parts azot = 79·0 oxygen + 21·0 hydrogen.
100 Parts of atmospheric air = 84·67 oxyg. + 15·33 hyd.
100 Parts of water = 85·66 oxygen + 14·34 hydrogen.
100 Parts of the gaseous oxyd of azot = 86·77 oxygen + 13·23 hydrogen.
100 Parts of nitrous gas = 93·28 oxygen + 6·72 hyd.
100 Parts of the nitrous acid = 94·33 oxyg. + 5·67 hyd.
100 Parts of the nitric acid = 95·70 oxyg. + 4·30 hyd.

May not oxygen and hydrogen be the two elements of which all bodies in nature are composed? To me this seems not at all improbable. It seems probable, also, that the heavier a body, the more it contains oxygen in a concentrated state, and deprived of caloric; and that, on the other hand, the more a body contains hydrogen, the lighter it ought to be. But these are merely hypotheses, which must be confirmed or refuted by future experiments.

It is seldom as simple bodies, but rather as compounds in different proportions, that the two constituent principles of azot enter into the combination of bodies. Carbon or the oxyd of the diamond is found in many bodies, and the diamond in none with which we are acquainted. We obtain carbon in our chemical decompositions, and not diamond. We do not even know the diamond or diamontic (adamantine) acid, though we know very well the carbonic acid. No chemist will think of saying that we exhale diamond in respiration, but carbon. The diamond, perhaps, is not even a simple body; in all probability it contains still oxygen; for all transparent bodies, if I am not mistaken, contain more or less of it. Thus, azot as well as carbon enters into several combinations as azot, as a double principle, which gives bodies very different

different properties from thoſe they would have were they combined with the two ſimple principles of which azot is compoſed. Azot, as a conſtituent principle of bodies, is not hydrogen and oxygen, but azot; in the ſame manner as ſoap is not oil and alkali, but ſoap. Of this obſervation we ought never to loſe ſight.

In ſeveral experiments I have obſerved that ſulphur often exhibits a yellow or yellowiſh orange colour. We ſhall ſeldom be deceived if we ſuſpect the exiſtence of ſulphur in all bodies which exhibit that colour. Bodies which contain carbon are black, brown, or violet. Azot announces itſelf by a green colour: ſtunted plants, which vegetate ſheltered from the air and light, are white, and contain very little azot: if expoſed to theſe two agents for ſome days, they aſſume a green colour, and the proportion of azot in their compoſition is much more conſiderable. When nitrat of potaſh is fuſed in a glaſs retort, and the oxygen gas is diſengaged from it, one may obſerve at the end of the operation, when the azot is formed, that is to ſay, when the oxygen has a greater affinity to the hydrogen than to the caloric, that the green colour appears, and the diſengagement of oxygen gas ceaſes entirely.

But what requires the attention of all philoſophers is, that when water is expoſed to the ſun the light decompoſes it, and diſengages the oxygen in a large quantity. The hydrogen then retains the laſt portions of the oxygen; azot is formed, and announces itſelf by its green colour; the water is more and more decompoſed; more of the oxygen (which I have demonſtrated to be the principle of life and irritability in organiſed nature) becomes fixed; and this azot, produced from water by means of the ſun, is an organiſed body, the *conferva fontinalis*; a plant which lives, expands, and perpetuates its ſpecies. Theſe are the boundaries at which the philoſopher ought to ſtop; it is here that he ought to admire and reſpect the ſecrets of Nature, without knowing whether he will ever be allowed to penetrate the veil by which they are hid. What is certain, and what I have aſſured myſelf of by a great number of experiments, with which I have been occupied every ſummer for more than twelve years, is, that the influence of the ſolar light is abſolutely neceſſary for this

 converſion

conversion of water into a plant or *organised azot.* No degree of heat can supply its place; and this single experiment might be sufficient to convince every unprejudiced reasoner, that heat and light are two substances entirely different. I am surprised that this green matter of Priestley, this *fontinalis*, should not have been more attended to by chemists. It is the most wonderful substance existing; the most singular body in nature. Nothing can be more absurd than what has been advanced by Priestley. To reason as he does, is to reason like a child. This celebrated man, whose name will live as long as the sciences are cultivated, has made most important discoveries. I admire his sagacity, but I am sorry to see in all his works that he is rather an experimenter than a philosopher. While he displays to us with one hand the astonishing secrets of Nature, he keeps the other always ready to close our eyes, lest we should show a desire of penetrating further than he chooses us to extend our view. He has given us a striking instance of his unwillingness to allow us to see the wonders of Nature, except through his sacerdotal glass, in the dispute which he had with Dr. Ingenhouz respecting the green matter in question. Ingenhouz, an enlightened naturalist, having described a great number of experiments respecting this singular substance, which are worthy the attention of every thinking being, adds: "The water itself, or some substance in the water, is, in my opinion, converted into this kind of vegetation. It is a real transmutation, which may appear incomprehensible to the philosopher, but which, at bottom, is not more extraordinary than the change of grass and other vegetables into grease in the bodies of graminivorous animals, and the change of the aqueous juice of the olive into oil."

Water is changed into a plant: such is the fact. There Ingenhouz stops. He says, I have no comprehension of the cause. This is the language of a philosopher. Priestley, on the other hand, is scandalised at this language; and he asks Dr. Ingenhouz, if he is not ashamed to attempt to revive the long ago refuted doctrine of spontaneous generation *. He speaks

* Priestley says that the theory of spontaneous generation is a doctrine long

speaks to him almost in the same manner as the inquisitor to Galileo when he endeavoured to prove to that immortal man that the sun moved round the earth. Priestley then gives us his own theory on the production of organised azot. The seeds of this plant, he says, float every where; in the air, on the earth, on the sea, on the Alps, in the plains, under the poles and the equator, in summer and winter, and in all seasons, and are received into the water, where they germinate: but organised azot is produced in bottles well corked. Dr. Ingenhouz has even proved, that by filling a bottle with well water, and inverting it in a bason filled with water, organised azot is formed in large quantities. Priestley, who could not maintain, without supposing an intelligence superior to the pretended seeds of this plant, that they had come through the water on purpose to settle in this bottle prepared for them, extricates himself from his difficulty by making them pass through the glass by imperceptible fissures*. Such

long ago refuted. The following are his own words: "*considering how long the doctrine of equivocal or spontaneous generation has been exploded.*" A philosopher ought never to make use of such an expression. There is no refuted opinion to which we may not recur, and again examine. Philosophy acknowledges no authority which can proscribe it from admitting, or forbid it to examine. There are many other opinions, long ago refuted, to which we ought still to recur; for example, that of the transmutation of metals. What chemist at present will dare to deny the possibility of it? The change of one metal into another ought to appear less difficult than the conversion of the sweetest body (sugar) into the sourest (oxalic acid); than the change of the hardest body (the diamond) into the softest (carbonic acid gas); than the change of the most transparent (the diamond) into the most opake (charcoal). In the 19th century the transmutation of metals will be generally known and practised. Every chemist, every artist will make gold; kitchen utensils will be of silver, and even gold, which will contribute more than any thing else to prolong life, poisoned at present by the oxyds of copper, lead, and iron, which we daily swallow with our food. There will then be no other riches than natural riches; the productions of the soil: artificial riches, such as gold, silver, and paper money, will vanish in the hands of those who have accumulated them. What a revolution in society! Every enlightened chemist, however, will agree with me, that this revolution is not only probable, but at no great distance.—*Note of the Author.*

* Through some unperceived fracture, Vol. III. p. 294. The seeds of this plant insinuate themselves into vessels of water through the smallest apertures, p. 308.

is the method which mankind have always employed when they did not choose to see what was only too evident. It is thus that phlogiston has been made to pass through crucibles, and azot through tubes and retorts.

I shall here observe, that to make these experiments succeed, it is absolutely necessary that the water should contain gas in solution, either oxygen gas or carbonic acid gas. The more gas it contains, the sooner organised azot will be formed in it.

It is much to be wished that chemists would examine with attention what changes earths undergo by the oxygen which they absorb by decomposing the steam of water. I have no doubt that such an examination would lead to very important discoveries. These ideas I submit to the knowledge and criticism of the illustrious French chemists the editors of the *Annales de Chimie*, the fathers of the science; by them it was created. Before them, chemistry was only a shapeless mass of facts, ill arranged and still worse explained.

IX. *Method of detecting the Presence of Sulphur and Arsenic in Ore, and of accurately determining the Quantity.* By B. G. Sage, *Director of the first School of Mines.*

THE torrefaction or roasting of a mineral disengages and decomposes the arsenic and sulphur it contains: but the earth of the metal is calcined, and lays hold of a portion of the acid and the water; which increases its weight, so that no just estimate can be formed of the proportions of sulphur and arsenic which the mineral contains. Besides, these two substances burn simultaneously: torrefaction, therefore, is not sufficient to afford any precision.

The distillation of two parts of the vitriolic acid with one of the pulverised mineral, which contains sulphur and arsenic combined with metallic substances, furnishes the means of determining with precision the quantity of sulphur and arsenic they contain. There first passes over sulphureous acid, which arises from the decomposition of the *metallic part* *, and of the

* The author here uses the term *metallisateur*, on which he has the following

the vitriolic acid; the ſulphur is diſengaged of a citrine colour, and the arſenic under the form of a white calx. The calcined metallic vitriol remains in the retort. By this proceſs I obtained from ſulphurous and arſenical cobalt ore,

White calx of arſenic	-	36
Citrine-coloured ſulphur	-	15
		51

Theſe ſubſtances ſerved to mineraliſe the cobalt, to give it the property of effloreſcing into vitriol of cobalt in a moiſt place. This ſalt is ſoluble in water; and in this it differs from the lilac-coloured arſenical effloreſcence of cobalt. Having treated in the ſame manner ore of nickel *, there paſſed over ſulphurous acid, citrine-coloured ſulphur, and white calx of of arſenic; there remained in the retort green calx of nickel in part vitriolated. The ſulphurous and arſenical ore of nickel which I employed had no matrix, and was covered with an effloreſcence of a dirty green colour: its internal tiſſue was gray inclining to red. It produced *per* quintal,

Sulphur	-	-	3
Arſenic	-	-	22
Nickel	-	-	75

X. *Experiments and Obſervations on Shell and Bone.* By Charles Hatchett, *Eſq. F.R.S.*

[Concluded from Page 29.]

THE bones of fiſh, ſuch as thoſe of the ſalmon, mackarel, brill, and ſkate, afforded phoſphat of lime; and the only difference was, that the bones of theſe fiſh appeared in general to contain more of the cartilaginous ſubſtance relative to

following note:—" Le metalliſateur eſt congénéré des huiles, des graiſſes; c'eſt le même *acidum* puiſque ſaturé de phlogiſtique et combiné avec moins d'eau; c'eſt le même acide qui eſt combiné avec les terres métalliques, qui forme les ſels qu'on nomme chaux métalliques."

* The *cuprum niccoli* of the French. *Niccolum Wallerii.* This celebrated mineralogiſt ſays, " Whence the mineral nickel acquired its name is uncertain. Nickel, perhaps, ſignifies the ſame thing as ſpurious or falſe."

 the

the phofphat of lime than is commonly found in the bones of quadrupeds, &c.

The different bones alfo of the fame fifh were various in this refpect; and the bones about the head of the fkate only differed from cartilage by containing a moderate proportion of phofphat of lime.

It is at prefent believed, that phofphat, with fome fulphat of lime, conftitutes the whole of the offifying fubftance; and perhaps the formation of bone from cartilage depends only on the phofphat of lime; but whether this is the cafe or not, it is fit that I fhould notice a third fubftance, which conftantly occurred in the courfe of my experiments.

When human bones or teeth, as well as thofe of quadrupeds and fifh, whether recent or calcined, were expofed to the action of acids, an effervefcence, although at times but feeble, was produced. This circumftance at firft I did not particularly notice; but the following experiments excited my attention:

After the phofphat of lime had been precipitated from the folutions of various teeth and bones by pure ammonia, I obferved that a fecond precipitate, much fmaller in quantity, was obtained by the addition of carbonat of ammonia. This fecond precipitate diffolved in acids with much effervefcence, during which carbonic acid was difengaged, and felenite was formed by adding fulphuric acid. Moreover the folution of this precipitate did not contain any phofphoric acid; nor did the liquor, from which the precipitate had been feparated, afford any trace of it.

This precipitate was therefore carbonat of lime; but I ftill was not certain that it exifted as fuch in the teeth and bones.

Although regular and comparative analyfes of the bones of different animals have not hitherto been made, yet by the experiments of Meffrs. Gahn, Scheele, Macquer, Fourcroy, Berniard, and the Marquis de Bullion, it has been proved that phofphat of lime is the principal offifying fubftance of bones in general, and that this is accompanied by a fmall proportion of faline fubftances, and by fulphat of lime.

I was therefore defirous to afcertain whether the carbonat of lime, which I had obtained by the above-mentioned experiments,

periments, had been produced from the fulphat of lime decompofed by the alkaline precipitant, or whether the greater part had not exifted in the bones in the ftate of carbonat.

Each of the folutions in nitric acid afforded a precipitate with nitrat of barytes; but the quantity of fulphuric acid thus feparated appeared by far too fmall to be capable of faturating the whole of the carbonat of lime obtained from an equal quantity of the folution. To prove, therefore, the prefence of the carbonic acid, and the confequent formation of carbonat of lime, portions of the various teeth and bones were immerfed at feparate times in muriatic acid; and the gas produced was received in lime-water, by which it was fpeedily abforbed, and a proportionate quantity of carbonat of lime was obtained.

Although it appears that the principal effects during offification are produced by the phofphat of lime, yet we here fee that not only fome fulphat, but alfo fome carbonat of lime enters the compofition of bones; and it is not a little curious to obferve, that as the carbonat of lime exceeds in quantity the phofphat of lime in cruftaceous marine animals and in the egg-fhells of birds, fo in bones it is *vice verfa*. It is poffible, when many accurate comparative analyfes of bones have been made, that fome may be found compofed only of phofphat of lime; and that thus fhells containing only carbonat of lime, and bones containing only phofphat of lime, will form the two extremities of the chain.

I fhall now make a few remarks on the enamel of teeth.

When a tooth, coated with enamel, is immerfed in diluted nitric or muriatic acid, a feeble effervefcence takes place, and the enamel is completely diffolved; fo alfo is the bony part; but the cartilage of that part is left, retaining the fhape of the tooth. Or if a tooth, in which the enamel is intermixed with the bony fubftance, is plunged in the acid, the enamel and the bony part are diffolved in the fame manner as before; that is to fay, the enamel is completely taken up by the acid, while the tooth, like other bones, remains in a pulpy or cartilaginous ftate, having been deprived of the offifying fubftance. Confequently, thofe parts which were coated or penetrated by lines of enamel are diminifhed in proportion

proportion to the thicknefs of the enamel which has been thus diffolved; but little or no diminution is obferved in the tooth *.

Mr. Hunter has noticed this; and, fpeaking of enamel, fays, "when foaked in a gentle acid, there appears no griftly or flefhy part with which the earthy part had been incorporated †."

Now when the difference, which has been lately ftated between porcellaneous fhell and mother-of-pearl, is confidered, it is not poffible to avoid the comparing of thefe to enamel and tooth.

When porcellaneous fhell, whole or in powder, is expofed to the action of acids, it is completely diffolved without leaving any refiduum.

Enamel is alfo completely diffolved in the like manner.

Porcellaneous fhell and enamel when burned emit little or no fmoke, nor fcarcely any fmell of burned horn or cartilage.

Their figure, after having been expofed to fire, is not materially changed, except by cracking in fome parts; their external glofs partly remains, and their colour at moft becomes gray, very different from what happens to mother-of-pearl or tooth. In their fracture they have a fibrous texture; and, in fhort, the only effential difference between them appears to be, that porcellaneous fhell confifts of carbonat of lime, and enamel of phofphat of lime, each being cemented by a fmall portion of gluten.

In like manner, if the effects produced by fire and acid menftrua, on fhells compofed of mother-of-pearl, and on the fubftance of teeth and bone, are compared, a great fimilarity will be found; for, when expofed to a red heat,

1ft, They fmoke much, and emit a fmell of burned cartilage or horn.

2dly, They become of a dark gray, or black colour.

* I have alfo obferved, that when rafpings of enamel are put into diluted nitric or muriatic acid, they are diffolved without any apparent refiduum; but when rafpings of tooth or bone are thus treated, portions of membrane or cartilage remain correfponding to the fize of the rafpings.

† Natural Hiftory of the Human Teeth, p. 35.

3dly, The animal coal thus formed is of different incineration.

4thly, They retain much of their original figure, but the membranaceous ſhells are ſubject to exfoliate *.

5thly, Theſe ſubſtances, (pearl, mother-of-pearl, tooth, and bone,) when immerſed in certain acids, part with their hardening or oſſifying ſubſtances, and then remain in the ſtate of membrane or cartilage.

6thly, When previouſly burned, and afterwards diſſolved in acids, a quantity of animal coal is ſeparated, according to the proportion of the gelatinous, membranaceous, or cartilaginous ſubſtance, and according to the duration of the red heat.

And laſtly, the acid ſolutions of theſe ſubſtances, by proper precipitants, afford carbonat of lime in the one caſe, and phoſphat of lime principally in the other, in a proportion relative to the membrane or cartilage with which, or on which, the one or the other had been mixed or depoſited.

As porcellaneous ſhell principally differs from mother-of-pearl only by a relative proportion between the carbonat of lime and the gluten, or membrane; in like manner the enamel appears only to be different from tooth or bone by being deſtitute of cartilage, and by being principally formed of phoſphat of lime cemented by gluten.

The difference in the latter caſe ſeems to explain why the bones and teeth of animals fed on madder become red, when at the ſame time the like colour is not communicated to the enamel; for it appears probable that the cartilages, which form the original ſtructure of the teeth and bones, become the channel by which the tingeing principle is communicated and diffuſed.

Theſe comparative experiments prove that there is a great approximation in the nature of porcellaneous ſhell and the enamel of teeth, and alſo in that of mother-of-pearl and bone; and if a ſhell ſhould be found compoſed of mother-of-pearl, coated by the porcellaneous ſubſtance, it will reſemble a tooth coated by the enamel, with the difference of carbonat being ſubſtituted for phoſphat of lime.

* This is a natural conſequence ariſing from their ſtructure.

Some experiments on cartilaginous fubftances (which I intended to have inferted in this paper, but which I am prevented from doing, as they are not as yet fufficiently advanced) have in a great meafure convinced me, that membranes and cartilages (whether deftined to become bones by a natural procefs, as in young animals, or whether they become fuch by morbid offification, as often happens in thofe which are aged) do not contain the offifying fubftance, or phofphat of lime, as a conftituent principle. I mean by this, that I believe the portion of phofphat of lime, found in cartilaginous and horny fubftances, to be fimply mixed as an extraneous matter; and that, when it is abfent, membrane, cartilage, and horn, are moft perfect and complete.

The frequent prefence of phofphat of lime in cartilaginous fubftances, is not a proof of its being one of their conftituent principles, but only that it has become depofited and mixed with them in proportion to the tendency they may have to form modifications of bone, or according to their vicinity with fuch membranes or cartilages as are liable to fuch a change. If horns are examined, few, I believe, will be found to contain phofphat of lime in fuch a proportion as to be confidered an effential ingredient. I would not be underftood to fpeak here of fuch as ftag or buck-horn, for that has every chemical character of bone, with fome excefs of cartilage; but I allude to thofe in which the fubftance of the horn is diftinctly feparate from the bone, and which, like a fheath, covers a bony protuberance which iffues from the os frontis of certain animals *.

Horns of this nature, fuch as thofe of the ox, the ram, and the chamois, alfo tortoife-fhell, afford, after diftillation and incineration, fo very fmall a refiduum, of which only a fmall part is phofphat of lime, that this latter can fcarcely be regarded as a neceffary ingredient.

By fome experiments made on 500 grains of the horn of the ox, I obtained, after a long continued heat, only 1,50 grains of refiduum; and of this lefs than half proved to be phofphat of lime.

* Nature feems here to have made an analyfis, or feparation of horn from bone.

78 Grains

78 Grains of the horn of the chamois afforded only 0,50 of residuum; and 500 grains of tortoise-shell yielded not more than 0,25 of a grain, of which less than half was phosphat of lime.

Now, it must be evident that so very small a quantity cannot influence the nature of the substances which afforded it; and the same may be said of synovia, 480 grains of which did not yield more than one grain of phosphat of lime.

This substance is undoubtedly various in its proportions in all these and other animal substances, arising, probably, from the age and habit of the animal which has produced them; but I believe that I may at least venture to place some confidence in the foregoing experiments, as several others, made since the above was written, have tended to confirm them *.

In the course of making the experiments which have been related, I examined the fossil bones of Gibraltar, as well as some glossopetræ, or shark's teeth. The latter afforded phosphat and carbonat of lime; but the carbonat of lime was visibly owing principally to the matter of the calcareous strata which had inclosed these teeth, and which had insinuated itself into these cavities, left by the decomposition of the original cartilaginous substance.

The bones of the Gibraltar rock also consist principally of lime, and the cavities have been partly filled by the carbonat of lime which cements them together.

Fossil bones resemble bones which by combustion have been deprived of their cartilaginous part; for they retain the figure of the original bone without being bone in reality, as

* These experiments were repeated on bladders, which I chose in preference to any other membrane, as not being liable to ossification, and therefore likely to contain very little or no phosphat of lime. 250 grains of dry hog's bladder, after incineration, left a residuum, the weight of which did not exceed 1-50th of a grain. This was dissolved in diluted nitric acid; and upon adding pure ammonia, some faint traces of phosphat of lime were observed. Now, as 250 grains of bladder did not afford more than 1-50th of a grain of residuum, of which only a part consisted of phosphat of lime, there is much reason to regard this experiment as an additional proof that the phosphat of lime is not an essential ingredient of membrane.

one of the moſt eſſential parts has been taken away. Now ſuch foſſil or burned bones can no more be regarded as bone, than charcoal can be conſidered as the vegetable of which it retains the figure and fibrous ſtructure.

Bones which keep their figure after combuſtion reſemble charcoal made from vegetables replete with fibre; and cartilaginous bones which loſe their ſhape by the ſame cauſe may be compared to ſucculent plants, which are reduced in bulk and ſhape in a ſimilar manner.

From theſe laſt experiments I much queſtion if bodies conſiſting of phoſphat of lime, like bones, have concurred materially to form ſtrata of limeſtone or chalk; for it appears to be improbable that phoſphat is converted into carbonat of lime after theſe bodies have become extraneous foſſils.

The deſtruction or decompoſition of the cartilaginous parts of teeth and bones in a foſſil ſtate muſt have been the work of a very long period of time, unleſs accelerated by the action of ſome mineral principle; for, after having, in the uſual manner, ſteeped in muriatic acid the os humeri of a man brought from Hythe in Kent, and ſaid to have been taken from a Saxon tomb, I found the remaining cartilage nearly as complete as that of a recent bone. The difficult deſtructibility of ſubſtances of a ſomewhat ſimilar nature appears alſo from the piercing implements formed of horn, which are not unfrequently found in excavations of high antiquity.

XI. *Deſcription of an Air and a Water-Vault employed to equalize the diſcharge of Air into a Blaſt-Furnace. By Mr.* David Mushet.

FIG. 1. (Plate XI.) repreſents a vertical ſection of the elevation of an air-vault 60 feet long and 30 feet wide, conſiſting of four arches of regularly progreſſive ſizes. This building is generally conſtructed under the bridgehouſe, where the materials are daily collected for filling the furnace. AB, repreſents the acclivity to the furnace top. The ſpace betwixt the arch-tops and the level of the floor is filled with materials as denſe as can be procured. The walls of the under part

part are three feet thick, besides a lining of brick and plaster from 18 inches to two feet. Still further precautions are necessary, and alternate layers of pitch and stout paper are requisite to prevent the escape of the compressed air. C, a view of the arched funnel which conveys the air from the cylinder to the vault. Large iron pipes with a well fitted door are preferable, and less apt to emit air. D, an end view of the pipe by which the blast is carried to the furnace.

Fig. 2. is a horizontal section of Fig. 1. at the dotted line *a b*, representing the width of the cross arches, which are thrown in each partition to preserve an easy communication betwixt the vaults. D, is a section of the first range of pipes, meant to conduct the air to the furnace. In like manner pipes may be taken off from any part of the vault for the different purposes of blowing furnaces, fineries, hollow fires, &c.

Fig. 3. represents a vertical longitudinal section of what is generally called the water-vault. The walls of this building may be erected to the height of eight or nine feet, their thickness similar to those of the air-vault. A brick lining, and even puddling with clay betwixt it and the stone building, is necessary to prevent the water from oozing by the accumulated pressure. A, is an end view of the horizontal range of pipes which conveys the blast from the blowing cylinder to the inverted chest. BBB, the range which conducts the air to the interior of the inverted chest, and conveys it to the furnaces, proceeding along the extremities of the columns broken off at BB. C, an inverted chest made of wood, iron, or even of well-hewn flags set on end and tightly cemented, is 54 feet within in length, 18 feet wide, and 12 feet high. The dimensions, however, vary at different works. When the chest is made of wood or iron, it is generally bolted by means of a flange to the logs on which it is supported, lest the great pressure of air should overcome the gravitation of the chest, and displace it. DD, view of the centre log, and ends of the cross logs, on which the chest is laid. These should measure 18 inches in height, so as that the mouth of the chest may be that distance from the surface of the floor, and the water allowed to retreat from the interior of the chest with the least possible obstruction. EE, the out-

ſide walls of the building. FF, the brick-work, made perfectly water tight. The dotted line G, repreſents the ſurface of the water when at reſt. Let the depth of the water, outſide and inſide of the cheſt, be eſtimated at four feet. When the engine is at work, ſhould the preſſure of the air have forced the water down to the dotted line H, $3\frac{1}{2}$ feet diſtant from the line G, and only ſix inches from the mouth of the cheſt, it follows, that the water muſt have riſen in the outer building, or cheſt, $3\frac{1}{2}$ feet above G, and have its higheſt ſurface nearly at reſt at I. In this caſe the ſtrength of the blaſt is reckoned equal to ſeven feet of water, or nearly ſix inches of mercury. The ſpace betwixt the cheſt and outſide building is three feet. When the engine is at reſt, and the water has aſſumed its level, the quantity of water within the cheſt ſhould be equal to that without.

Fig. 4. is a ground plan of Fig. 3. The croſs logs on which the ciſtern is ſupported are dotted within, but drawn full in the ſpace betwixt the flange of the cheſt and outer building. The breadth of the flange-tops of the binding bolts, and thickneſs of the metal of the cheſt, are alſo drawn. The letters bear a reference to thoſe in No. 3.

NEW PUBLICATIONS.

The Chemical Pocket-Book, or Memoranda Chemica; arranged in a Compendium of Chemiſtry according to the lateſt Diſcoveries, &c. By James Parkinson. Symonds; Murray and Highley, &c. 230 Pages: 12mo. Price 5s.

On a plan of general arrangement, nearly ſimilar to thoſe of Fourcroy and Chaptal, Mr. Parkinſon has brought together, in this little volume, almoſt all the *principles, facts, affirmations* and *theories* of modern chemiſtry. If we could be content with an aſſemblage of facts, not wrought into regular ſyſtem, nor preſented in continuous compoſition, few late chemical publications would deſerve to be preferred to this one. In forming it, the compiler has laid under contribution

tribution every recent work from which any chemical gleanings could be gathered. His induſtry deſerves praiſe, and his book cannot fail to be uſeful in no mean degree; though we fear that in a few caſes he has admitted facts of uncertain authenticity, and theories not ſufficiently ſupported.

An Eſſay on the Theory and Practice of Bleaching, &c. By WILLIAM HIGGINS, *M. R. I. A.* London: Vernor and Hood, 1799. 71 Pages: 8vo. Price 2s.

Science is truly beneficial only in its application to the uſes of life. But for theſe uſes, we ſhould little value all the improvements of modern chemiſtry. There exiſts not, however, in any language, a treatiſe in which art and ſcience are brought into alliance more happily than in that which is now before us. It was publiſhed at the requeſt of the Right Hon. Mr. Foſter and the Right Hon. Mr. Corry of the Iriſh Houſe of Commons. It is intended for the peruſal and inſtruction of actual bleachers. It explains the nature of flax, as being coloured by a reſin that intimately pervades all its fibres. It explains in detail the practices of the old method of bleaching, which diſcharged the weaver's dreſſing by ſteeping in water; then, for a courſe of many weeks, applied alternate expoſure to the open air, and ſteeping or boiling in alkaline lixivia, to bring all cloths of flax to perfect whiteneſs. It relates the manner of the applications of oxygenated muriatic acid in oxy-muriat of lime to abbreviate and perfect the bleaching proceſs. It laſtly propoſes, as the cheapeſt and beſt of all modes of bleaching, the alternate uſe of ſteeps of oxy-muriat of lime, and ſteeps of ſulphuret of lime, which in the courſe of ten days will bring green linen to a ſtate of pure whiteneſs. We earneſtly recommend this treatiſe to general attention.

Tranſactions of the Royal Society of Edinburgh, Vol. V. Part I. for 1799.

This Part contains the following papers:

I. Inveſtigation of certain theorems relating to the figure of the earth. By Mr. Playfair.

II. Account of certain phenomena obſerved in the air-vault

vault of the furnaces of the Devon iron-works; together with ſome practical remarks on the management of blaſt-furnaces. By Mr. Roebuck. (See the preſent number of the Philoſophical Magazine, p. 324.)

III. Experiments on whinſtone and lava. By Sir James Hall, Bart.

IV. A chemical analyſis of three ſpecies of whinſtone and two of lava. By Dr. Robert Kennedy.

V. A new method of reſolving cubic equations. By James Ivory, Eſq.

INTELLIGENCE,

AND

MISCELLANEOUS ARTICLES.

LEARNED SOCIETIES.

ROYAL SOCIETY OF LONDON.

SINCE our laſt report, ſeveral intereſting papers by Dr. Herſchel, on the ſubject of his late diſcovery reſpecting heat and light, have been read. Doctor Herſchel, purſuing his late diſcovery of what he calls the inviſible heat-making rays of the ſun, has inveſtigated, and experimentally proved, that heat is occaſioned by rays emanating from candent ſubſtances; and that theſe rays have a power of heating bodies, and are ſubject to the laws of reflection and of refraction. The Doctor divides heat into ſix claſſes; three of which are ſolar, and three terreſtrial. On account of the ſimilarity between the former and the latter, he reduces his ſubject to three general heads. He treats in his firſt diviſion of the heat of the ſun and of terreſtrial flame; in the ſecond, of the heat of priſmatic rays and of red-hot iron; and in the third diviſion, of the inviſible heat-making rays of the ſun, and of terreſtrial inviſible or dark heat in general.

Papers on the following ſubjects have alſo been read:

An account of an earthquake felt in the vale of Conway, between Conway and Llanrwſt, on the 12th of March laſt. By J. Lloyd, Eſq.

Experiments on platina. By Wm. Bingley, Eſq. aſſay-maſter of the Mint.

A poſtſcript by Mr. Howard to his paper on fulminating oxyd of mercury, containing an account of ſome experiments made with it at Woolwich; from which it appears, that 1 oz. burſt a ſhell which would have required 7 oz. of gunpowder; and that half the charge of oxyd uſually employed of gunpowder would burſt any piece of ordnance. A remarkable property of this preparation is, that when fired with gunpowder the latter does not deflagrate.

A paper, by S. Schroeter, on the planet Mercury. From his obſervations it appears, that its mountains bear the ſame proportion to its diameter as thoſe of Venus and the Moon do to theirs, and that the higheſt mountains are in its ſouthern hemiſphere; alſo, that its rotation on its axis is performed in ſeventy-four hours.

PHILOMATIC SOCIETY OF PARIS.

C. Jurine read lately a memoir on the *monoculus caſtor*. Under this name the author includes the *monoculi* of which Muller very improperly formed three ſpecies, *viz.* the *cyclops, cæruleus, rubens*, and *lacinulatus*. The *cæruleus* is nothing elſe, indeed, than an old female of the *rubens*; and the character of the *lacinulatus* conſiſts merely in foreign appendages, or a kind of infuſion animals which often adhere to this *monoculus*. C. Jurine having ſucceſſively reduced ſeveral of theſe inſects to a ſtate of aſphyxy by means of a few drops of ſpirits thrown into the water which contained them, and having revived them by adding new pure water, obſerved, that it is not the heart but the inteſtinal canal which retains longeſt its irritability, and reſumes it the ſooneſt. The female carries her eggs not in two cluſters, like the greater part of the other cyclops, but in a large bag, which has a little reſemblance to the tail of the beaver. It is from this circumſtance that the author gives to the above ſpecies the name

name of *castor*. The right antenna of the male has a hinge by means of which he lays hold of the threads that terminate the tail of the female to force her to copulate. When the two sexes copulate, they are in an opposite direction.

C. Cuvier read a note on the fossil tapirs of France. The author announced, that there are dug up in France the bones of two kinds of tapirs; one of the size of the common tapir, which is no longer found alive in America, and the other of a size equal to that of the hippopotamus, and of which living individuals no where exist. Both these kinds, like the common tapir, have teeth (grinders) the summit of which is marked with two or three transversal eminences or ridges that become blunted with age. Among the animals known at present, there is none but the *lamantin* which participates in this character with the tapir. The want of incisive and canine teeth, however, and the form of the jaw-bones of the lamantin, by no means permit them to be confounded with those of the tapir. The author has seen two considerable portions of the lower jaw of the former, or small species, in the cabinet of C. Drée. They were found on the last declivities of the Black Mountain, near the village of Issel, in the department of Herault, in a bed of coarse gravel. They have no sensible difference from the analogous parts of the common tapir. In regard to the large species, the author knows of four specimens: 1. An extreme grinder found in a ravine near Vienne, in Dauphiny, and described and illustrated by a figure in the *Journal de Physique* for February 1773: 2. A considerable portion of a grinder found by C. Gilet-Laumont at Saint-Lary, in Comminge: 3. The germ of a grinder without roots, preserved in the National Museum of Natural History: and 4. The two halves of a lower jaw, containing each five grinders, but broken at both ends, and consequently without the incisores or canine teeth, and without any determinate form. It may be easily seen that four of these grinders have transversal eminences, as those of the tapir; and that the one before is alone flat at the top, and without any protuberance. It is probable that the animal was not full grown, since it wanted the extreme grinder with three protuberances, and that the one next to it had not been used. From the size of these teeth

teeth it evidently appears, that the animal to which they belonged muſt in bulk have been equal at leaſt to the hippopotamus, or perhaps to the elephant. It is not known where theſe two portions of the jaw were found; they are in part incruſted with ſand.

C. Laſteyrie, who is now travelling through the north of Europe, has addreſſed a letter to the Society on the introduction of the fine-woolled breed of ſheep into the cold countries. Near Leyden and Haarlem, in Holland, he obſerved that the climate, though damp, does not prevent the breed of the Spaniſh ſheep from thriving. He ſaw the fourth generation of theſe animals, bred in the country, which had as fine wool as the Spaniſh ſheep, though both the ſoil and the climate were in appearance very unfavourable to the conſtitution of theſe animals. In another letter he ſays he found the ſame ſucceſs in Denmark and Sweden, and even in the moſt northern parts of theſe two countries, where that breed have exiſted for many years. He mentions in particular, that the Daniſh government, two years ago, ſent for three hundred Spaniſh ſheep, only one of which has died in the courſe of that time notwithſtanding the ſevere cold of the laſt winter.

In the annual ſitting on the 10th of January C. Sylveſter made a report of the labours of the Society during the year. At the ſame time

C. Lacroix read the eulogy of Borda, and C. Coquebert that of Bloch.

BRITISH MINERALOGICAL SOCIETY.

This Society has juſt circulated the following notice of its proceedings:

" It is now ſome months ſince public notice was given of the inſtitution of the Britiſh Mineralogical Society; one of the principal objects of which is, the gratuitous analyſis of ſuch of our native minerals as may be ſent to the Society by mine-owners, or other perſons who are intereſted in the inquiry. The Society's firſt meetings were neceſſarily much occupied in eſtabliſhing arrangements for the moſt effectual attainment of its own deſigns and thoſe of its correſpondents. Both theſe objects have, we truſt, been ſatisfactorily provided

 for;

for; and the number of ſpecimens ſent to the Society fo analyſis, evince at the ſame time the utility of the ſcheme and the public confidence.

"The Society conſiſts of a competent number of members in the habitual practice of chemical operations, each of whom undertakes an analyſis in rotation, (aſſiſted, in caſes of peculiar intricacy, by a ſelect committee,) the reſult of which, after general approbation, is tranſmitted by the ſecretary to the perſon who ſent the ſpecimen. Since, however, ſeveral of our correſpondents, from inadvertence, have not complied with the conditions mentioned in the circular letter of the Society, we here repeat them, with the addition of ſome others, and beg to have it underſtood that no analyſis will be undertaken where theſe are not complied with:

"1. The whole of each ſpecimen muſt be at leaſt four pounds weight, and in as few pieces as poſſible. The perſon who ſends the ſpecimens, if more than one, ſhould break a ſmall piece from each, taking care to reſerve and mark them with the ſame numbers as thoſe that he ſends to the Society; becauſe, in the analyſis returned to him, the different ſpecimens will be diſtinguiſhed by their numbers: the ſafeſt way of marking each will be to write the number on a ſlip of paper, and fix it on the ſpecimen with gum-water. Every piece muſt be wrapped in paper, and packed in a box with ſaw-duſt, addreſſed (carriage paid) to Mr. W. H. Pepys, Poultry, London.

"2. A paper muſt accompany the ſpecimens, ſtating their provincial names; the name of the pariſh and county where they are found; the depth of the mine or quarry where they are procured; the general extent and bearing of the vein or ſtratum towards the points of the compaſs; and the method of procuring them, whether by blaſting or by the pick-axe, &c.

"3. The Society alſo requeſts, that the metallic ores which may be ſent them for analyſis may be accompanied with ſpecimens of the gangue or matrix in which they are found, and of the ſuperincumbent ſtrata, with their reſpective depths and provincial appellations, according to the following form*:

* The blanks, and parts printed in *Italics*, to be occupied by their proper deſcription.

"Specimen

"Specimen No. 1, called by the miners [*steel-grained potter's lead ore*] found at [   ] mine, in the parish of [   ] county of [   ]; [40] fathoms below the surface, in a [*regular vein from 2 to 24 inches across*] lying [*N. W. and S. E.*] rising to the [*N. W.*], procured by [*blasting*]. The ore found mixed with [*black-jack* specimen *No. 2, and spar No. 3,*] in a [*slate-rock*]. Depth of strata cut through in sinking the mine, [*soil 1 foot; gravel 5 feet, No. 4; rock 30 fathoms, Nos. 5 and 6; shale 2 fathoms, No. 7; slate-rock 7 fathoms, No. 8.*]

"The Members of the British Mineralogical Society have in view, besides the above, another object of perhaps still greater general importance. In common with all other inquirers into this most interesting department of natural history, they have regretted the formidable obstacles to collecting accurate information in the mining districts, originating from the vague and peculiar terms in use among the miners, and from the different ideas annexed to the same terms in different parts of the country. They feel the impossibility of introducing a scientific nomenclature into the mines and collieries, and in consequence have arranged correspondences in various parts for the purpose of collecting materials towards a general explanatory dictionary of all the mining terms made use of in the British islands. The success of this plan, it is obvious, depends essentially on the public concurrence; its advantage cannot be called in question, and therefore the Society requests with confidence the assistance of those gentlemen who, from their local situation, or other circumstances, are able to further its execution, and are willing that the whole science of mineralogy should be cleared from that confusion and mystery in which it has been enveloped. Besides lists and explanations of technical terms, the Society wishes to be furnished with specimens of such minerals as have received any names in the mines and collieries: without the possession of specimens it will be impossible to identify the substances so as to assign them their proper scientific appellations; and these being deposited in the cabinet of the Society, will form a constant record and authority, to which the most liberal access will at all times be allowed.

 "The

" The confcioufnefs of contributing in their fphere to the public good, and to the improvement of a favourite branch of natural fcience, is the fole remuneration which the Members of the Society look forward to; and they will efteem the time and expenfe employed in the analyfis of minerals amply repaid, if thofe whom they have thus ferved will exert their perfonal activity and influence among their workmen, in furthering the execution of the above defign, by the communication of illuftrative fpecimens and explanatory lifts of technical terms.

" It is the intention of the Society to affociate as correfponding Members a felect number of fuch perfons, competently fkilled in mineralogy, as may be zealous to affift its views; and that proprietors of mines, who have it much in their power to furnifh fuch facts and fpecimens as are of principal importance to the Society, fhall be confidered as eligible to the clafs of correfponding Members; all of whom, though they are to be fubject to no pecuniary contribution, fhall be allowed free accefs to the meetings and to the cabinet."

GALVANISM.

Mr. Carlifle has lately made fome interefting experiments which prove the identity of the electric and galvanic fluid. A number of plates of filver (fay, 40 or 50 crowns or half-crowns) piled alternately with plates of zinc, with pieces of wetted pafteboard between each to complete the galvanic chain, will not only give an electric fhock to the perfon who touches the top and bottom of the feries, but continue to give an uninterrupted ftream of the electric fluid, which being paffed through water, decompofes it completely. If gold, filver, or platina wire be employed to carry the electric matter into and from the water, both oxygen and hydrogen are liberated; but if oxydable metals are employed, hydrogen only.

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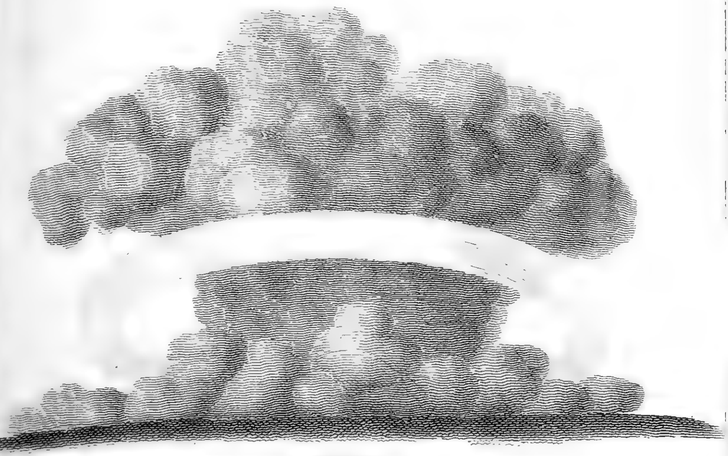
Platina,

Thunder-

END OF THE SIXTH VOLUME.

Printed by Davis, Wilks, and Taylor, Chancery-Lane.

Fig 1



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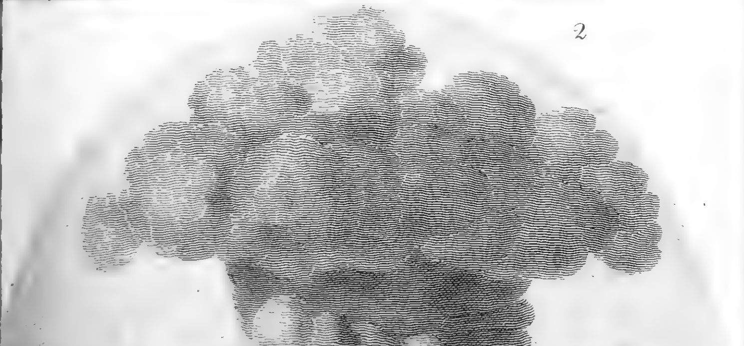
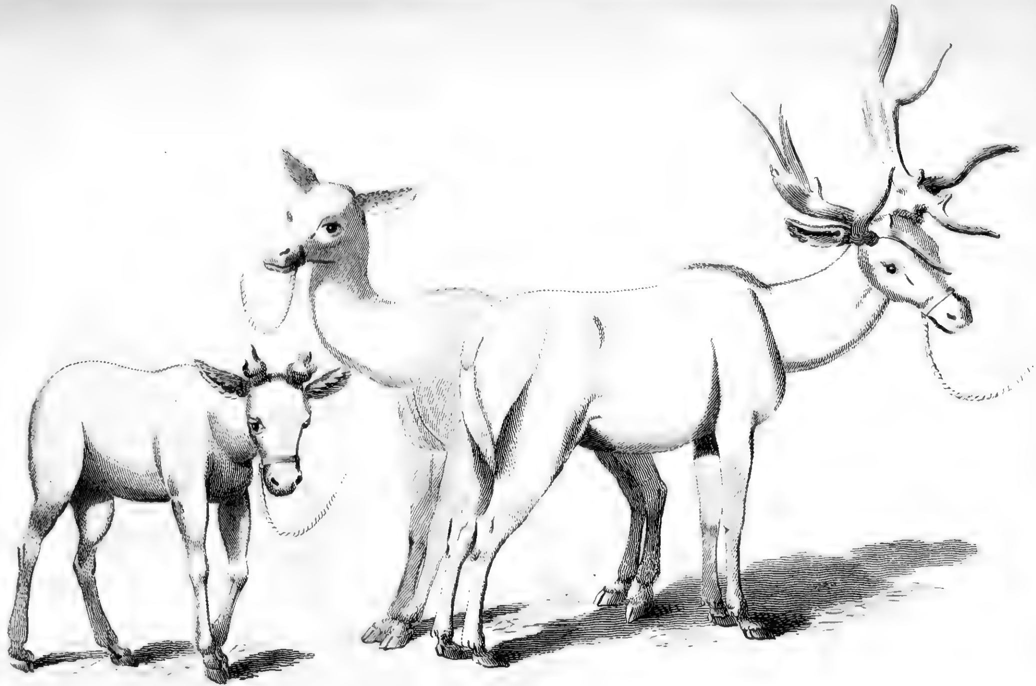
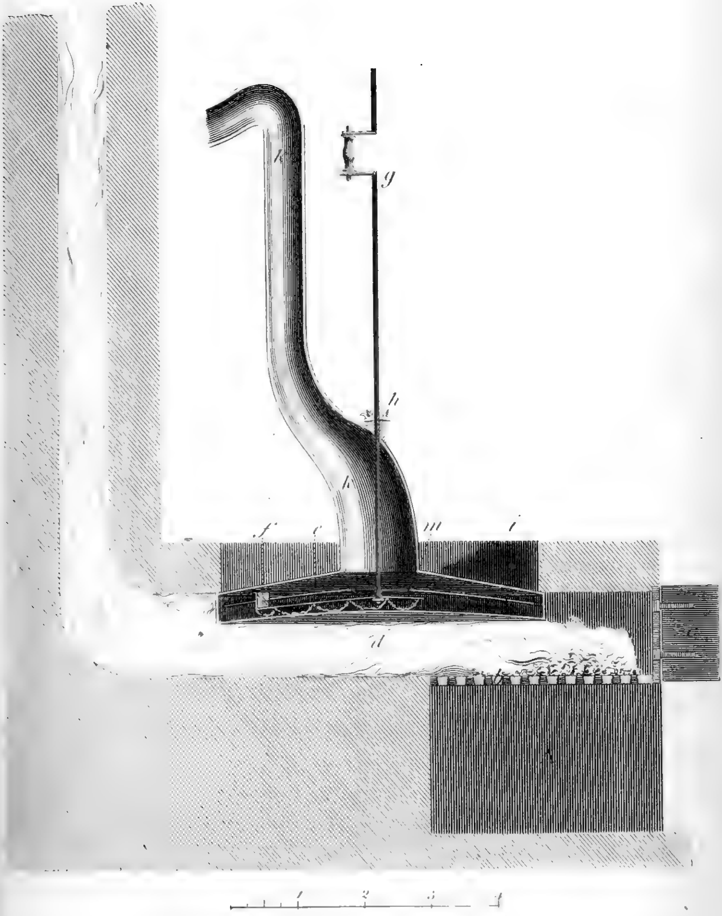






Lowry sculp.

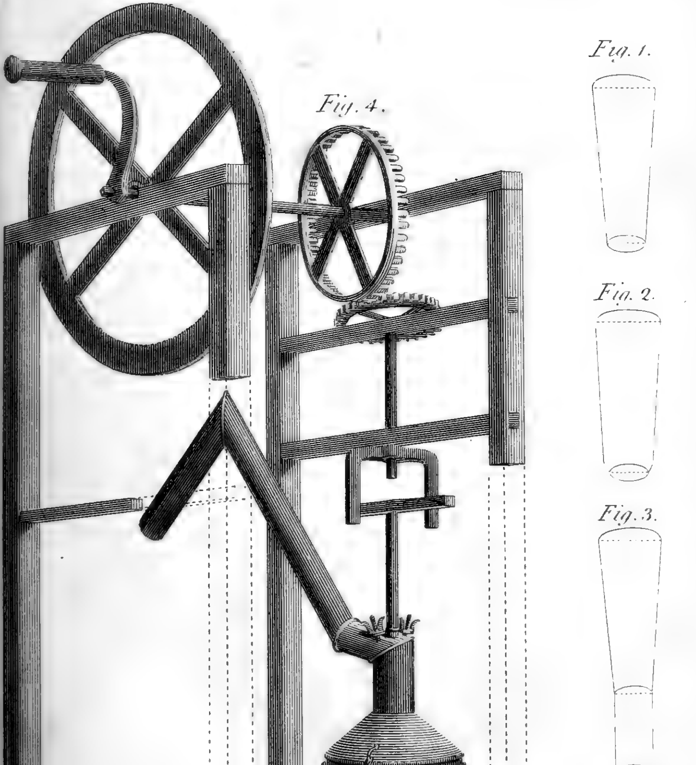


Fig. 1.

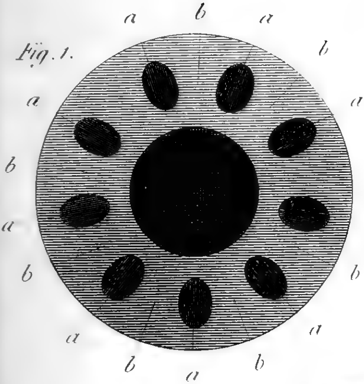
Fig. 2.

Fig. 3.

Fig. 4.

Lowry

Fig. 1.



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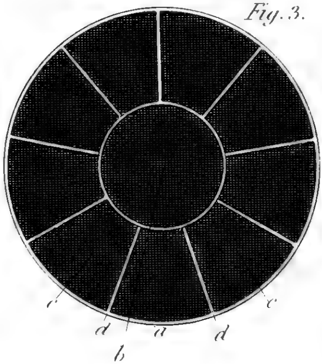

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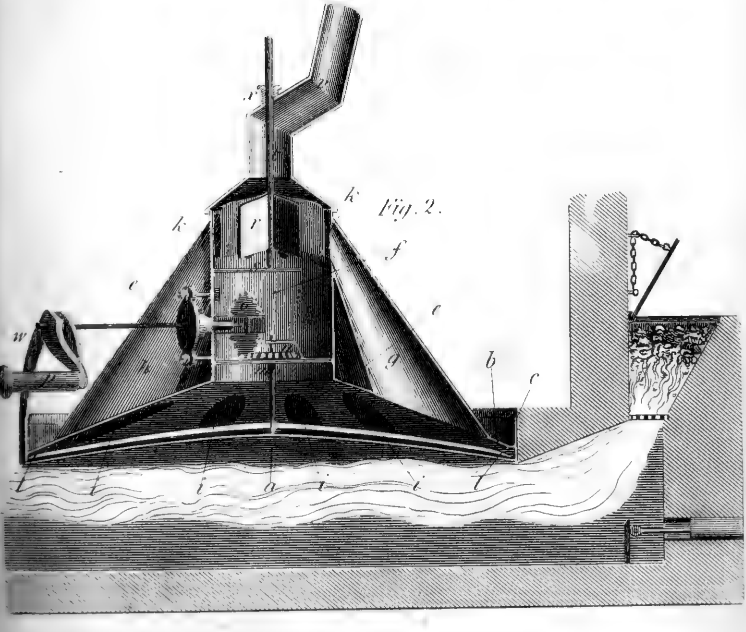

Lowry sculp.


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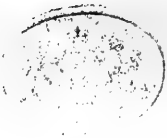
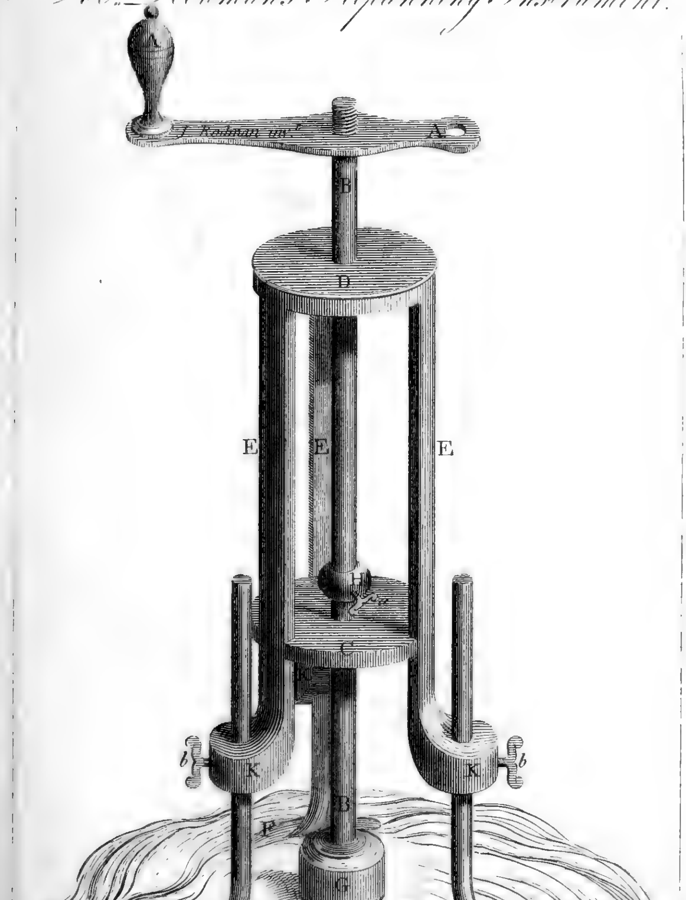


Mr. Rodman's Trepanning Instrument.



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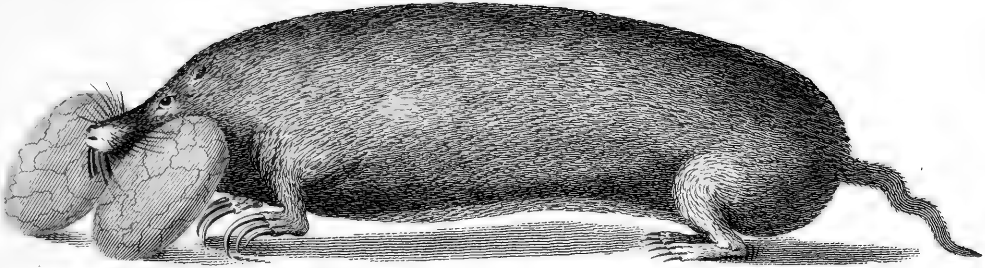
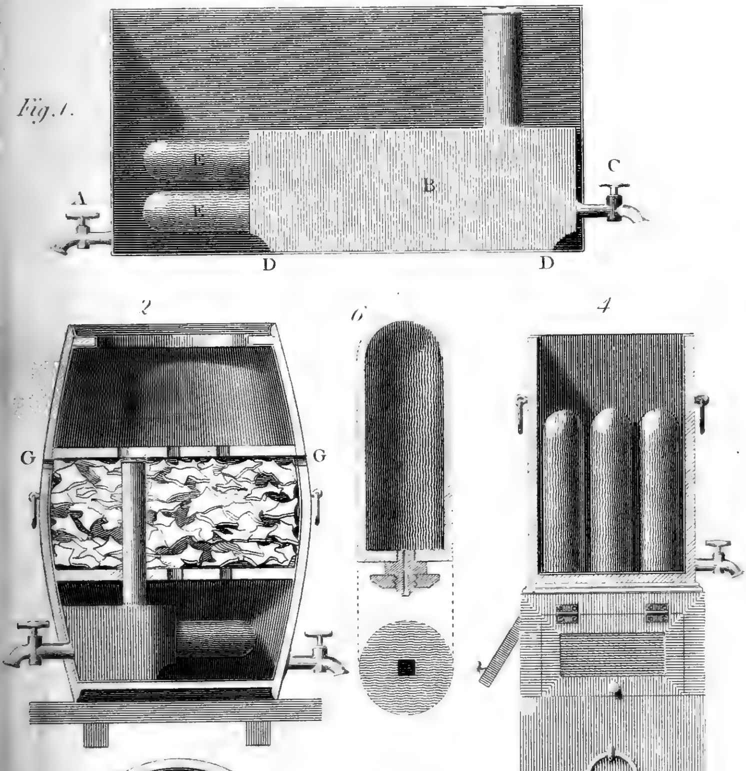


Collier's improved Apparatus.



Drawn & Engraved by Lowry

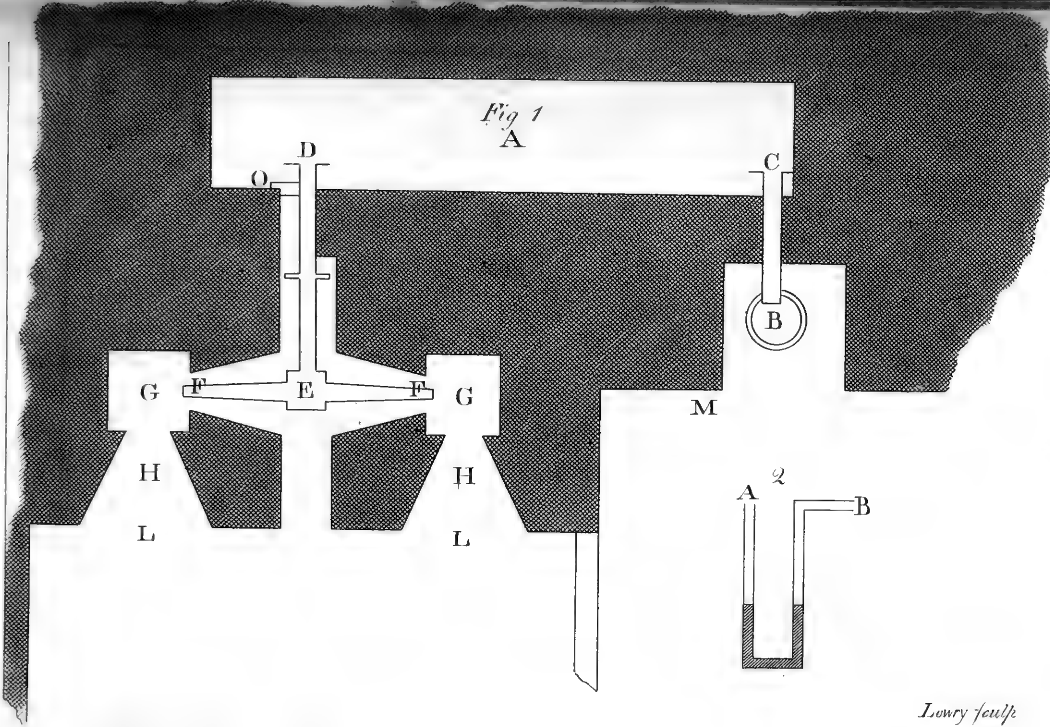


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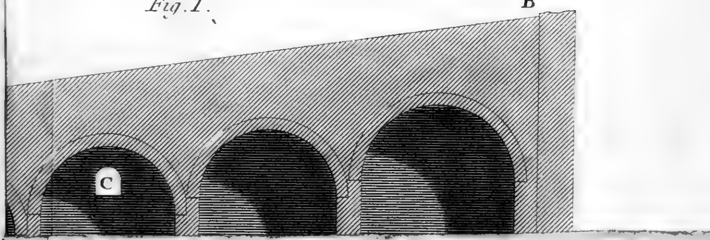
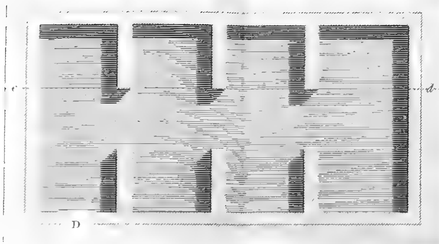
Fig. 1.





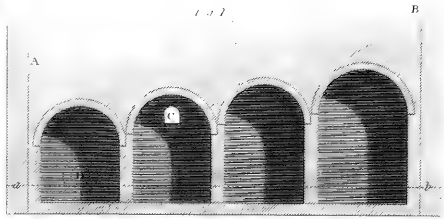


Fig. 4